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ENGINEERING NEWS-RECORD

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

F. E. SCHMITT, *Editor*

Volume 103 NEW YORK, OCTOBER 24, 1929 Number 17

A Compact Society

CONTRASTING with the Boston meeting of the American Society of Civil Engineers, with its five technical division meetings, the convention of the American Society of Municipal Improvements at Philadelphia last week was a well-integrated conclave. So far this organization has resisted the tendency of latter days to make a congress out of a convention. It is true that the A.S.M.I. had too full a schedule; yet the more than forty papers on its program were read to sessions of the entire body, there was discussion, and technical committees had opportunity to report in open meeting and receive official recognition. Papers of similar kind were grouped; the program committee properly assumed that every city engineer is as much interested in one phase of municipal engineering activity as in another. Such diverse subjects as garbage and airports, regional planning and street lighting, financing methods and utility standards of service all had their technical committees. Every member of the society had a chance to hear the results of committee action and to vote on standard specifications. In this way the growing need which the municipal engineer has felt in recent years to widen the range of his thinking is reflected in his organization.

Wind Vibration Again

MOST impressive of the indications flowing from the broken hangers in the just completed Tacony bridge over the Delaware River, reported last week, is the serious danger that may lie in the susceptibility of structural members to vibration under specially unfavorable circumstances. No failure quite similar to that of Tacony has been recorded in structural history, so far as present memory serves, although it has certain aspects that recall the wind-vibration failure of the Realty Board and Meyer-Kiser buildings in Miami. Floor hangers of great length and very substantial section—18-in. I-beams nearly 100 ft. long—broke after short service, in spite of the fact that they were but lightly loaded. Apparently resonant vibration was the essential cause of the breaks. Because of the relatively large section of the members and the resulting low tension, their vibration was distinctly different from that characteristic of the light truss bridges of former days, and could attain a much larger amplitude. The possibility of such a result had not been foreseen in any manner by the engineers, in spite of the firm's exceptionally large and thorough experience. This fact brings out very clearly the elusiveness and variability of vibration phenomena. At the same time it lays new emphasis on the arguments for rigid construction in bridge work. The entire profession may rightly congratulate itself on the fact that, although several hangers broke, the breaks were so distributed that more extensive failure did not occur, the floor framing spanning the gap until temporary support could be provided at the breaks. In the investigation necessary to determine what repair measures are to be used the engineers should uncover important factors bearing on the cause of failure. They thus stand in the enviable position of being able to enrich materially the legacy of structural design.

A Reform Needed

ZONING laws are justified solely because they lead to better living conditions. When this objective is furthered, the laws are proper, but when, as occasionally happens, they interpose handicaps to public convenience, false conceptions of their inviolability should not prohibit proper modification. An instance of ill-advised regulation is the widespread prohibition of large garages in residential districts. The automobile is an accepted and necessary adjunct of American family life. When not in use it must be stored, either in a building or on the street. The latter alternative is impossible, both because it is illegal and because it interferes with the proper flow of active traffic. Private houses are permitted individual garages, but what of the inhabitants of large apartment houses, the number of which is steadily increasing? Multiple-family dwellings create the need for multiple-car garages, yet the construction of these is often forbidden in sections where they are most needed. Large garages need not be eyesores; they have been and can be made as architecturally pleasing as an apartment house. Indeed, there is a growing tendency to provide space for automobile storage in the apartment house itself, when this is permitted. Such a course should be encouraged, for it is the best solution to an urgent problem. Zoning laws which prohibit necessary garage construction fail in their purpose and work against public welfare.

Men and Machines

THE transformation in operating conditions on the Pere Marquette Railway which Frank H. Alfred refers to elsewhere in this issue as having been brought about through greater efficiency on the part of the men in working with better equipment and facilities is worthy of note. It is typical of what has been done on many other railroads and is the reason behind much of the increased prosperity of the railroads today. In 1928 the Pere Marquette with 10,258 employees handled 3,205 million ton-miles of freight as compared with 2,449 million ton-miles moved by 12,227 employees in 1920. In the same period all the railroads of the country reduced the number of their employees from 2,022,000 to 1,657,000 and increased their ton-mileage by 26,495,000,000. In that period five billions of dollars were added to the property investment in new and modernized equipment, in larger yards and better track, in improved grades and line, and in a multiplicity of other facilities for the more expeditious movement of freight. But all this inanimate equipment could not have brought about the transformation which is typified in the Pere Marquette;

a willingness on the part of the employees to do their bit in moving more freight at less cost was essential. One other factor Mr. Alfred modestly refrains from mentioning. Without the vision of the railroad executives who in the dark years following the war had the courage to borrow vast sums for new equipment on the prospective increased earning capacity which the new facilities should produce the transformation never would have come about.

Natural Gas Fuel

A LAW passed at the last session of the California legislature requires the conservation of all natural gas taken out of the ground in the process of developing oil. Under this new law, which became effective Sept. 1, markets must be developed immediately for an enormous quantity of natural gas. For example, in the Kettleman Hills oilfield in California three wells are producing 250,000,000 cu.ft. of gas per day, which, translated into equivalent power, would be about 1,000,000 kw. Heretofore surplus natural gas has been wasted into the atmosphere as the quickest and easiest means of disposal. Under the new law all surplus gas from operating wells and from such new wells as may later be developed must be conserved—that is, sold or put to some useful service. This means that the price will be very low, for oil operators would be most reluctant to shut down profitable wells. Electric power companies in the territory within easy transmission distance of the oilfields are taking advantage of this low-cost fuel. They are assured by oil geologists that the gas supply will be dependable for many years to come even if no new oilfields are developed, because the feasibility of getting more oil and gas from operations at greater depth in many existing fields has been demonstrated. The Kettleman Hills field is only 175 miles north of Los Angeles, and a 250-mile line to San Francisco was put into service this month. A striking feature of this new factor in Coast power matters is that it may seriously affect the Boulder Canyon project. Unless power from that project can be generated and transmitted to southern California cities at a cost not greater than the cost of gas-field steam power, the possibility of financing the project through contracts for its power—as required by the Boulder dam act—will be endangered.

For Better Building

STUDY such as carried out by the Forest Products Laboratory on the distortion strength of wood-stud wall construction is a commendable undertaking. The frame building had little aid from scientific study in the past; it evolved empirically, with virtually no attention from the man who might have dictated and developed its design—namely, the architect. As in other fields where the architect has ignored technical design and craftsmanship, it is now necessarily taken up as an engineering problem. There is reason for believing that scientific analysis supplemented by laboratory study can do much to make frame-building construction better. Experiences in great windstorms of recent years, such as the Illinois and St. Louis tornadoes and the Florida hurricane, revealed major weaknesses that need to be analyzed and remedied. Just as important are the distributed imperfections which lead to premature loss of service value of wood frame buildings through settlement, shrinkage, distortion and vulnerability to attack of parasites and fire. There is good promise that these shortcomings can all be reduced by a consistent study of causes and remedial expedients.

Difficult Tasks Made Easy

ONE of the principal advantages that welding offers the structural engineer is a facility for making certain hitherto difficult tasks comparatively easy. Mostly these tasks center on repair work, although others, such as connecting new steel to an old building frame, give the statement a general applicability to the whole structural field. Periodically, accounts of repair jobs made easier by virtue of welding have been published in this journal. In the Bound Brook bridge, new chords and web members were inserted into each of the four trusses, and all floorbeams were strengthened without disturbing the traffic passing over or under the structure. More recently an ingenious plate-and-turnbuckle arrangement was welded into previously non-adjustable diagonal tension members in a railway bridge near Pittsburgh, to make possible a more efficient and safer distribution of loads. This week H. T. Welty, of the New York Central Railroad, describes how 107 plate girders in the roof of a tunnel were repaired by welding on new bottom cover-plates. A distinctive feature of the work was the ingenious method of transferring dead-load stress to the new cover plates by heating them just before welding. To accomplish the same result without welding would have involved awkward and costly work; welding made the difficult task easy, more certain in its successful accomplishment, and more rapid. It is more and more becoming apparent that the engineer who would have a complete inventory of methods at his command must consider welding as one of the tools available for his use.

Canalization of the Ohio

CANALIZATION of the Ohio River from Pittsburgh to Cairo, a distance of 968 miles, is complete. The river is now open through its entire length for boats of 9-ft. draft, an accomplishment of great magnitude, brought about through the expenditure of something over $100,000,000 during a period of twenty years. Opening of the deeper draft channel marks the beginning of a new epoch in inland water transportation in this country, because it removes the barrier which has shut off the Pittsburgh and other industrial districts of the Ohio Valley from direct connection with barge lines on the Mississippi River and with coastwise and oceangoing shipping. It will make possible a determination of whether or not the opening of channels on the Ohio River of sufficient size for modern barges will restore that stream to its former position as an important factor in our inland transportation system.

Even with the limited possibilities which it has possessed heretofore the Ohio River system has handled a considerable amount of local traffic, made up in large part of coal and coke moving between the mines and industrial plants in the Pittsburgh district and of coal moving down from the Huntington district to Cincinnati. Steel from the Pittsburgh district moving down the river to the Mississippi amounted to only 300,000 tons in 1928 as compared with 9,000,000 tons of all commodities in the Pittsburgh district.

Where the points of origin and destination of freight both are on the same waterway, as in the case of much of the coal and coke movement on the Ohio, water is

ideal for the shipment of bulk commodities, especially where the time factor is not important. And where the point of origin of a bulk commodity like steel is on a waterway which provides a long haul to a point of transshipment, as with steel coming down from the Ohio to points on the lower Mississippi River, a waterway also presents a distinct advantage. Nowadays, however, the elements of time and certainty of movement as well as the cost of transshipping from water to rail are factors working against the use of inland waterways. Where the points of origin and destination both are off the waterway, the chances that freight will move by that route are poor.

Prospects for the development of the Ohio River as a great traffic artery are bright. With large industrial districts such as those of Pittsburgh and Cincinnati producing steel, coke and other bulk commodities, and with much coal still close to water on the tributaries, there is every reason to believe that an increasing amount of such commodities will move down the river through the enlarged and stabilized channel. The extent to which less bulky commodities will move on the river is yet to be determined. But if a general freight business does not develop on the Ohio with all the advantages which it possesses, any scheme to construct other waterways primarily for that purpose may as well be abandoned.

Dry Concrete

THAT dry concrete surpasses wet concrete in strength, density and durability has been recognized many years, in some degree ever since the earliest days of portland cement. Up to a quarter-century ago concrete was mixed extremely dry, and laboriously placed with much hand tamping. Because of the difficulties and excessive cost of placing dry concrete, wetter mixtures came into use, for practical means to handle and place dry concrete at a reasonable cost were lacking. A period of popularity of very wet mixtures followed, during which the subject of quality tended to be forgotten. But within the last year or two, with dry concrete again claiming its rightful place, the problem of depositing and consolidating dry mixtures less laboriously than by the old-time methods has engaged much study.

Two methods used on three concrete dams are the result: one method developed on the Diablo dam for Seattle's water supply and another in use in building dams for hydro-electric plants at Calderwood, Tenn., and Kenogami, Que. At Diablo, as was described in an issue of Aug. 29, 1929, p. 320, the dry concrete was handled by a belt-conveyor layout arranged similar to a chuting system with movable, counterweighted conveyors mounted on a tower. Satisfactory placing was accomplished by depositing continuously through a vertical spout which was constantly moved to spread the concrete evenly in thin layers. Compaction was attained by the dropping, and tamping or working was not thought necessary.

A further step in handling dry concrete is found on the two other projects, described in this issue. The concrete is mixed so dry that mechanical vibrating or tamping is required to compact it into place. Handling difficulties were overcome by the adoption of special straight-side dump buckets. By correct manipulation of electric high-speed vibrators so as to affect all parts of the mass, each batch as deposited is shaken into a dense, compact mass homogeneous with the material previously placed. The sponsors of this radically different method of placing claim that labor costs are no higher than for placing wet concrete, while material costs are considerably lessened by a saving in cement, and they consider the method so successful that it will be used on future projects already planned.

These operations, though widely differing in methods of application, constitute epoch-making steps in the change from concrete pouring to concrete placing. They are practical, large-scale demonstrations of the fact that dry concrete can be handled and placed well and economically. For reinforced and narrow-dimension construction, mixtures capable of easy flow may still be necessary, but for mass construction undoubtedly all concrete pouring will give way to concrete placing in the future.

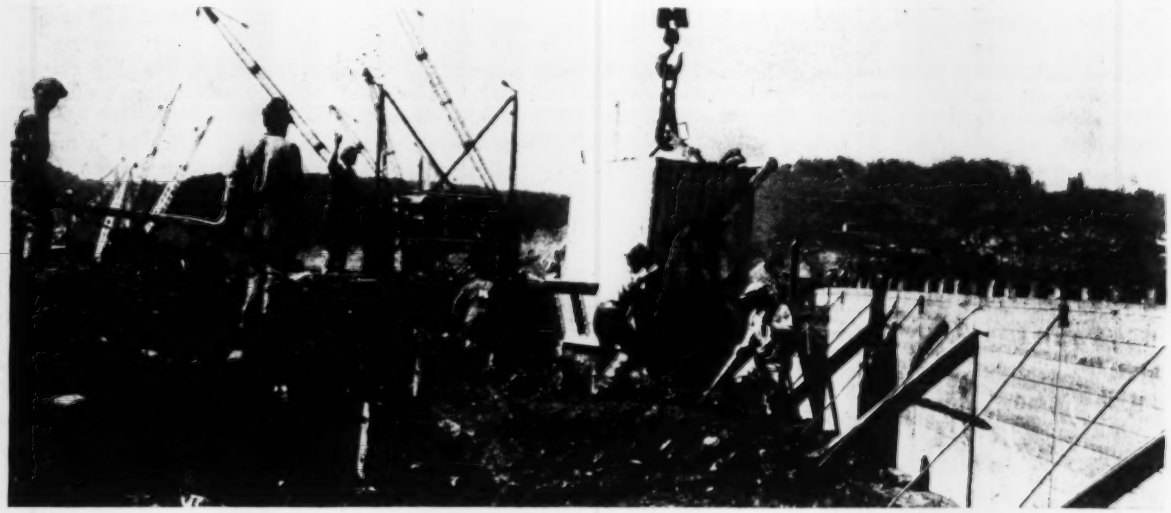
Licensing Contractors

CALIFORNIA officials have announced their intention of rigidly enforcing the contractors' license law which became effective Aug. 15. It will be well to watch the effects of this law, for in it lies a possible solution of the ever-growing demand for prequalification of contractors. The act is not one of prequalification, as a license must be issued to every applicant, requiring only a statement of the general nature of his business and the names of members of his corporation. Under the new law, an owner claiming fraud, abandonment or other irregularities on the part of a contractor in prosecuting the works may protest to the Director of the Department of Professional and Vocational Standards, who acts as a judge. If the contractor is found guilty, his license is revoked and he is not permitted to continue in business within the state. The contractor may appeal to the Director, and if the appeal is denied, can then turn to the state Superior Court.

Prequalification alone does not guarantee the owner that a contract will be properly carried out. At best it is merely an assurance that the contractor is properly equipped and financially able to do the work. Hiring a licensed contractor is a much more definite assurance that the contract will be properly fulfilled. After a contractor has performed under the new act, retaining his license is proof that his work has been satisfactory. Furthermore, the ever-constant possibility of having his license revoked will spur the contractor into properly fulfilling his part of the contract. A provision in the original bill for examining the applicants before issuing a license, which amounts to prequalification, was finally stricken out to get the act passed.

From the standpoint of the contractor the law is a desirable one—in fact, it was sponsored among others by the California chapter of the Associated General Contractors. The contractor has nothing to fear if he is carrying on his work diligently. He is protected from petty grievances on the part of the owner, because the law demands specific facts from the complainant, who must be prepared to stand back of his action. Though the immediate decision in case of complaint rests with one man, an appeal by the contractor automatically restores his license until final decision is made, thus avoiding interference with his other work in the meantime.

The act appears to be equally advantageous to the construction industry and the building public. If properly administered it will eliminate the so-called irresponsible and unscrupulous contractor, for one example of bad conduct would be sufficient to preclude further activities within the state. But the test of its success will lie in its intelligent administration.



Placing Concrete in the Dam at Chute a Caron

Exceptionally Dry Concrete Used on Two Large Dams

Placing of Dry Mix Made Possible by Using Electric Tampers Upon the Concrete in the Forms—No Small Stones Allowed in the Aggregate—Concrete of Great Density and Far Exceeding Specified Strength of 3,000 Lb. Being Produced

USING electric vibrators to compact concrete mixed so dry that it stands in a stiff heap when dumped from the buckets is the revolutionary practice in concrete placing being carried out by the Aluminum Company of America on two of its widely separated hydro-electric projects, one near Kenogami, Que., the other at Calderwood, Tenn. The concrete is designed for a strength of 3,000 lb. per sq.in. at 28 days in accordance with the water-cement ratio law, using 4.5 sacks of cement per cubic yard and large aggregates varying from 2 to 6 in. Mixing and placing methods are identical on both projects, the only variations being slight differences in the water-cement ratio and in the sizes and kinds of aggregates.

Aggregates—At the Chute a Caron project near Kenogami, Que., the sand is obtained from glacial deposits. Screening out the gravel produces a sand having a fineness modulus of about 3.0, carrying from 2.5 to 3 per cent clay. The coarse aggregate is mostly anorthosite (granite) taken from the canal and dam excavation. This rock is first passed through a 66-84-in. primary jaw crusher and a No. 15 secondary gyratory crusher and then passes over a revolving screen having 2-in. circular openings. All material retained on the screen, varying from 2 to 6 in. in size, is used as coarse aggregate; all material passing the screen is wasted.

Crushed rock, an extremely hard arkose (sandstone) is used for both fine and coarse aggregate on the Calderwood dam, being obtained from an adjacent quarry and from tunnel excavation. The rock is put through a No. 21 gyratory crusher and then through a revolving screen with 3-in. circular openings. All material retained on the screen, varying in size from 3 to 6 in., is used as coarse aggregate. Much of this rock is more than 6 in. in one dimension. Material passing the screen is further crushed and rolled to reduce it to sand.

Experience has shown that by scalping out all material under the 2-in. and 3-in. sizes a mix can be secured which has a lower mortar content and yet is

FIG. 1—DUMPING 4-YD. BATCH OF STIFF CONCRETE, CALDERWOOD DAM

Note the way concrete is piled up in bucket even after half-mile railroad haul. The straight-side 4-yd. buckets were made specially for handling this dry concrete.

more workable than one containing the smaller aggregate. Broken stone having a natural grading from 0 to 6 in. was found to have a marked tendency toward segregation and grouping of smaller sizes in storage bins and in the larger mixers. Inclusion of the smaller stone produced a harsh mixture requiring a mortar content of 125 per cent of the voids in the stone. Omitting the smaller sizes not only checked the tendency to segregate in the bins and mixers but produced a workable mix having a mortar content of 110 per cent of the voids in the stone.

Mixing and Transportation—On both projects the stone and sand are proportioned by volume, and the cement, delivered in bulk, is weighed for each batch. Approximate proportions of the mix at Calderwood are 1:3:4.5, with a water-cement ratio of 0.05; and at Chute a Caron 1:2.3:4.6, with a water-cement ratio of 0.80. Expressed in terms of slump, this would

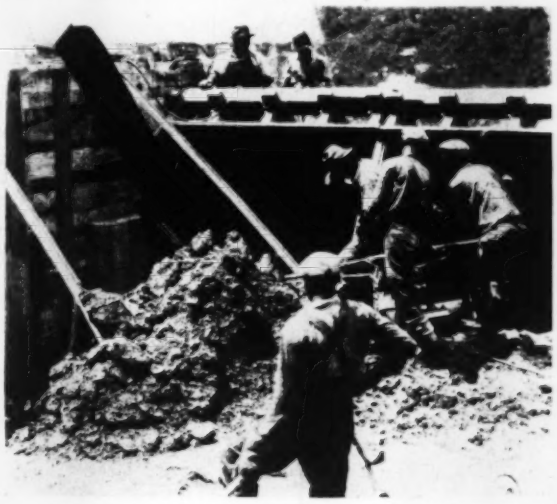


FIG. 2—BATCH OF CONCRETE JUST DUMPED AND BEFORE VIBRATING

be somewhat less than 1½ in. Water in the mix is carefully controlled by calibrated tanks. Hourly tests are made to determine the amount of free moisture in aggregates, and the amount of water is varied accordingly. Mixing is done by 4-yd. tilting mixers, one mixer being used at Calderwood and two at Chute a Caron. All are fitted with special nickel-steel baffle plates and linings. The batches are held in the mixer fully two minutes after all materials are in the drum. Transportation from the mixing plant to the job is by 4-yd. straight side bottom-dump buckets set on standard flat cars handled by steam dinkeys. As it was found that the usual type of bottom dump buckets with flaring sides would not discharge the dry-mixed concrete without a great deal of trouble, the special straight-side buckets were made for this work.

At Calderwood the haul is about 2,000 ft., but at Chute a Caron the maximum haul is 3 miles from the mixer to the job. On the long haul the concrete not infrequently is 50 minutes old by the time it reaches the forms. All concrete over one hour and fifteen minutes old is rejected.

Concrete Placing—The buckets are handled from the cars to forms by guy derricks. A bucket about to be dumped is shown in Fig. 1, and Fig. 2 shows this same load after being dumped. Immediately after being

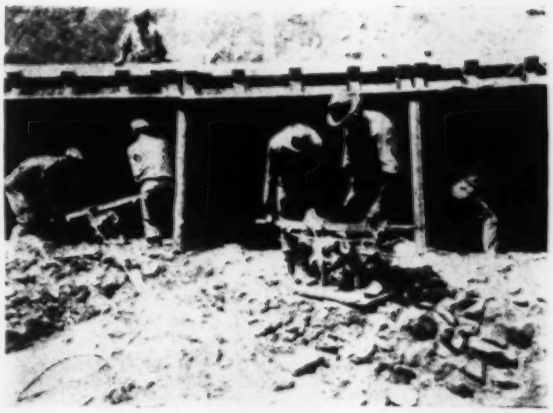


FIG. 3—VIBRATING MACHINES AT WORK

dumped, the batches are compacted and worked down by two or three electric vibrators, each handled by two men. The vibration in a pile of concrete is started near the lower edges, the vibrators working up toward the peak as the sides slump down. In five minutes or less a 4-yd. batch of stiff concrete is worked into a mass homogeneous with that previously placed.

The vibrators consist of a ¼-hp. three-phase induction motor weighing 23 lb., with an unbalanced rotor, mounted on a wooden tamping foot about 2½ ft. long and 1 ft. wide, handled by a short spring-mounted wooden pole. They operate at a speed of 3,600 revolutions per minute. The machines have a vibratory rather than a tamping effect, apparent for a depth of 16 in. The vibrators are more effective when the two workmen stand on the foot block. In the same manner as driving piling in stiff mud with a high-speed air hammer, the larger stones in the batch are driven down into the concrete. Figs. 3 and 4 show a batch being compacted, also the appearance of the concrete after vibrating.

At the beginning of a lift grout is used to provide bond with the previous lift.

Testing—Well-equipped testing laboratories are maintained on both jobs, and the inspectors have supervision over all mixing and placing operations. All cement is tested on the job. The concrete is designed for a

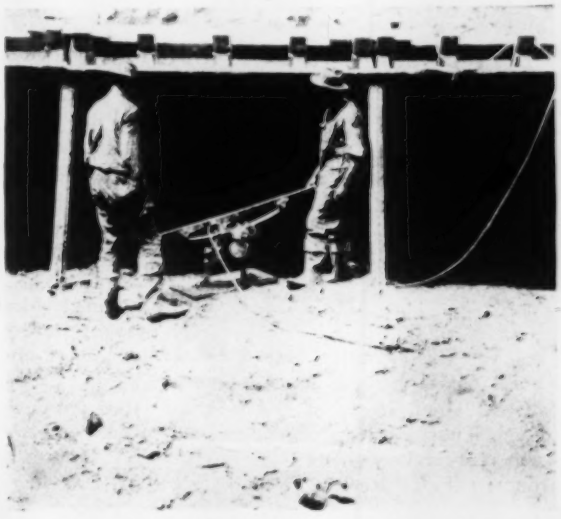


FIG. 4—APPEARANCE OF CONCRETE AFTER VIBRATING

FIG. 5—VIEW OF VIBRATING MACHINE

strength of 3,000 lb. per sq.in. at 28 days. When tested in an 8x16-in. cylinder all aggregate over 2 in. was removed. However, it was found that some of the cylinders of this size could not be broken in the 200,000-lb. testing machine on the job and that the use of large aggregate in smaller specimens gave very erratic results. Consequently 6x12-in. mortar cylinders are being used, excluding all aggregate above $\frac{3}{8}$ in. Tests determined that the 6x12-in. mortar cylinders showed approximately 10 per cent higher strength than the 8x16-in. concrete cylinders. On this basis, the concrete is considered meeting the requirements if the mortar cylinders test 3,300 lb. per sq.in., or 110 per cent of the 3,000 lb. specified concrete strength.

When the use of this class of concrete was under consideration an elaborate series of tests was made upon 30x72-in. concrete cylinders using full-size aggregate and 6x12-in. mortar cylinders from the same batches. These cylinders were tested at the U. S. Bureau of Standards in Washington. Results showed that the 6x12-in. mortar cylinders had strengths approximately 25 per cent higher than shown by the large concrete cylinders. Therefore the mortar cylinders being made on the job are assumed to have 125 per cent of the actual strength of the concrete in the dam. The 6x12-in. mortar cylinders are averaging 4,000 lb. per sq.in. at 28 days at Calderwood and 3,740 lb. per sq.in. at Chute a Caron, the difference being due probably to the better sand at Calderwood.

On both projects there is a small amount of 1,500-lb. concrete being placed in gravity sections, using a water-cement ratio of 1.20 and a mix of approximately 1 : 3.6 : 7.5. Mortar cylinders in this class of concrete average 2,330 lb. The concrete is mixed dry, placed and vibrated in the same manner as the 3,000-lb. concrete.

Personnel—The Aluminum Company's construction forces are building both projects under the direction of James W. Rickey and James P. Growdon, chief and assistant hydraulic engineers, respectively, and T. J. Bostwick, chief electrical engineer for the company. J. E. S. Thorpe is superintendent and W. R. Johnson is concrete technician at Calderwood. At Chute a Caron, I. G. Calderwood is superintendent and I. E. Burks is concrete technician. Mr. Burks and Mr. Johnson provided much of the information here given.

Unusual Methods Used in Repair of Roof Girders in Street Underpass

Dead-Load Stress Placed on New Cover Plates by Torch Heating Prior to Arc Welding—Special Plant Car Developed by Contractor

By H. T. Welty

Engineer of Structures, New York Central Railroad, New York, N. Y.

THE Port Morris Branch tracks of the New York Central Railroad pass under Brook Ave. in the borough of the Bronx, New York City, between East 157th St. and East 159th St. through what is in effect a tunnel with a roof construction of steel beams spanning between the side walls and carrying concrete jack arches which spring from the bottom flanges. The steel is entirely incased with the exception of the bottom cover plates. The roof was constructed in 1898 and until quite recently steam locomotives were used in the freight movements on this branch. The limited clearance over the tracks, 15 ft. 9 in., and the length of the tunnel, about 600 ft., were contributing factors to severe corrosion of the exposed steel from locomotive gases. Due to this corrosion of the bottom cover plates and the increasing weight of street traffic, it became necessary to undertake strengthening or reconstruction. The plan adopted included a novel method of subjecting the new cover plates to dead-load stress by heating them with torches immediately prior to their attachment by arc welding. The project is also of interest because of the contractor's plant, which was planned to meet conditions of repair under heavy traffic movement.

Brook Ave. is a busy city street and the surrounding property is also entirely occupied by buildings. Entire reconstruction would have entailed a very large expenditure and would have seriously interfered with street traffic. Therefore reconstruction was inadvisable except as a last resort.

Inasmuch as the girders, if of original section, would have had sufficient strength, reinforcing by restoring the corroded cover plates was a possibility. Riveting was first considered as a means of attaching the cover plates, but was discarded because undercutting of the concrete jack arches would have been necessary to permit in-

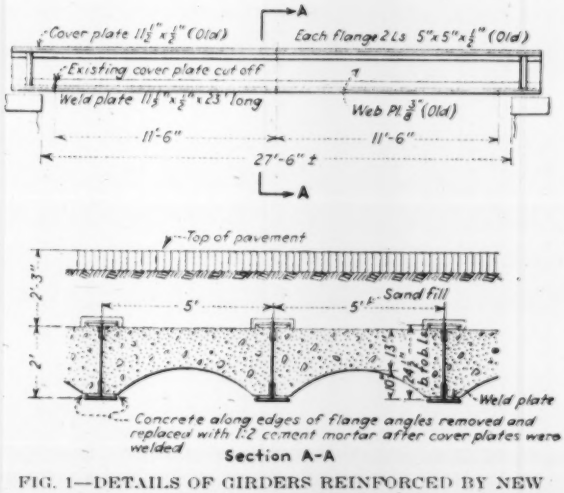


FIG. 1—DETAILS OF GIRDERS REINFORCED BY NEW ARC-WELDED COVER PLATES

serting and driving the rivets. The alternative appeared to be electric welding, and as there was but little vibration under passing street traffic and practically no cutting away of the concrete would be necessary, this method was decided upon. A total of 107 girders had to be repaired.

To be effective, the strengthening material had to take its proportion of dead-load stress as well as live-load, which in this case was of particular importance because of the heavy dead load carried. Various methods were proposed for doing the work, including suggestions from several of the bidders, especially as regards means of transferring dead-load stress to the new plates. The method finally adopted and which worked out very satisfactorily, was as follows:

Starting at one end, the old cover plates were removed from several of the beams, the steel was thoroughly cleaned and the old rivet shanks were chipped off flush with the backs of the flange angles. At intervals the concrete was cut away sufficiently to permit placing clamps to hold the new cover plates securely in position during the welding.

With a plate in position, the first step was to make a continuous 30-in. weld on each side at one end, two welders operating. The plate was then heated by means of torches to a temperature of about 100 deg. F., or enough to get an elongation of about 0.1 in., corresponding to a stress of 11,000 lb. per sq.in. in the plate. The moment this expansion was secured, the 30-in. welds at the free end were started, and were completed before the plate had cooled. Thereafter tack welds were made at intervals of 3 in. on each side. Strain-gage readings were taken on several plates, and the measured stress in the plates agreed closely with the stress desired. The flange angles were of course relieved of stress by the amount taken by the plate.

Two gas-driven direct-current 200-amp. welding generators were used, working at 160 amp. and 20 volts during welding operations. The welding electrodes were $\frac{5}{32}$ in. and $\frac{3}{16}$ in. in diameter and contained from 0.13 to 0.18 per cent carbon.

The contractor's plant is of especial interest. It was possible from a railroad operating standpoint to permit the contractor to use one track during the greater part of each working day and to block both tracks for limited periods, but his operations had to be so arranged as to permit clearing the tracks at short notice. To accomplish this he constructed a welded structural steel operating bridge which was mounted on a flat car. This bridge was of approximately the same width as the car and a few feet less in length than the distance between the side walls. It was mounted on a turntable and was attached to the car body by a pivot bolt about which it could be rotated. The bridge in operating position stood at right angles to the car and parallel to the beams and was supported at the outer end by a temporary wooden post. The bridge in this position permitted the men to work freely on a cover plate. When necessary to clear up for a passing train, the bridge was readily swung 90 deg. in a few minutes, and if necessary to clear both tracks, the entire plant was shifted to a sidetrack by a switch engine.

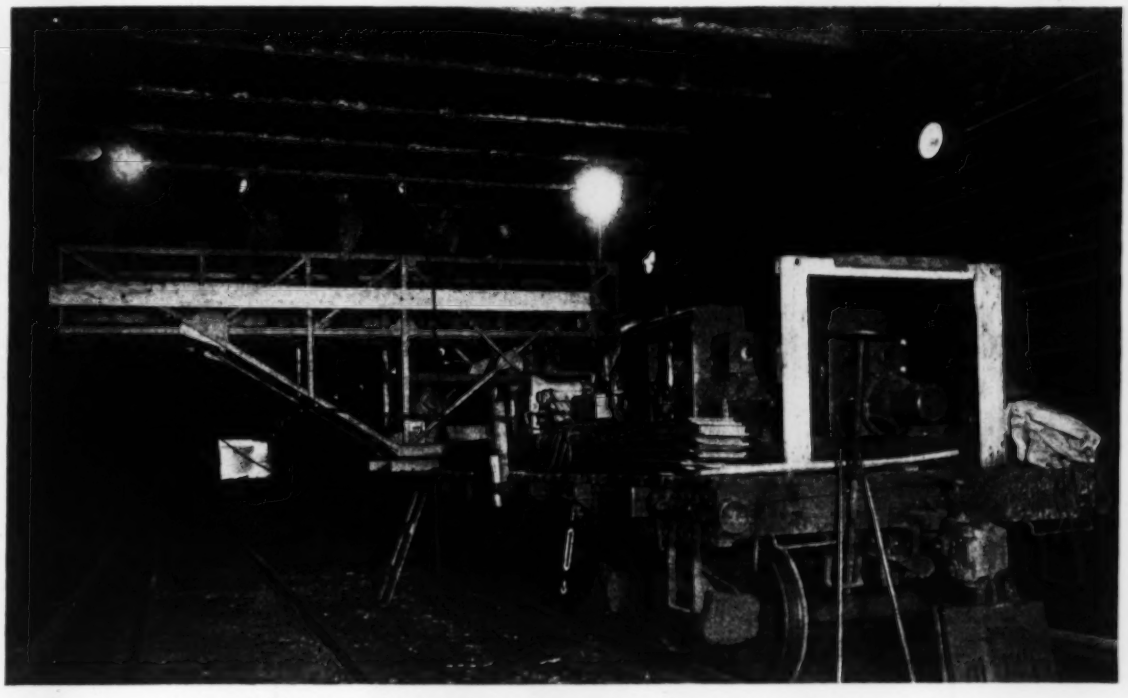
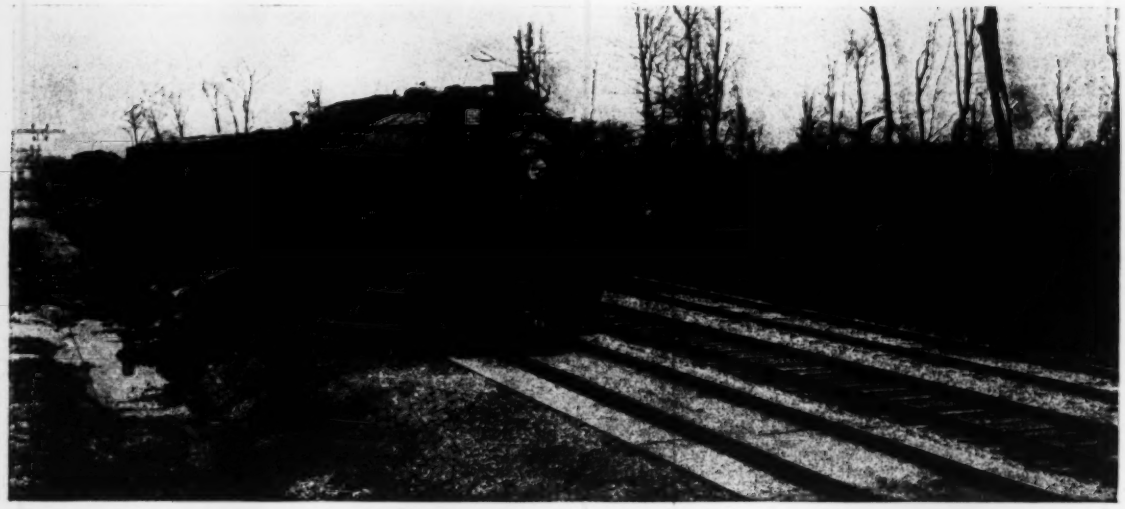


FIG. 2—SPECIAL CAR EQUIPMENT USED TO REPAIR STREET UNDERPASS GIRDERS
Staging revolves, clearing passing track. Note new cover plates clamped to roof girders. Heating plates with torches followed by welding places necessary initial stress in plates.

In addition to the revolving bridge, the flat car carried all the welding equipment and a supply of material, as shown in Fig. 2. The job progressed rapidly and satisfactorily, and there were no delays whatever to train service.

The work was planned by and executed under the direction of the engineering department of the railroad company. The Leake & Nelson Company, of Bridgeport, Conn., was contractor for the work and has applied for patents covering the above-described method of reinforcing structural members, including the equipment used.



Train on Concrete Track, Pere Marquette Railway

Operating Economies on the Pere Marquette

How Betterments Lead to Increased Earnings Shown by Comparison of Railway's Affairs in 1920 and 1928—High Efficiency of Employees an Economic Factor—Review of Improvements—Operating Ratio Reduced From 91 to 68—Traffic Developments

By Frank H. Alfred
Vice-President, Pere Marquette Railway

How an individual railway system has improved its property and increased its operating economy in spite of unfavorable conditions is shown in the accompanying article. It represents a policy that has proved successful on many other railroads, but the astonishing decline in passenger traffic appears to be a permanent situation for which no remedy is apparent. It is of interest to note that the author has been closely identified with both the technical and administrative aspects of this aggressive policy, having been successively chief engineer, general manager, president (under a former organization) and now vice-president of this one railroad system. —Editor.

ONE of the most noticeable phases of the post-war industrial development in the United States is the increased output per man. In this respect the railroads have not fallen behind the procession. In 1920 the Pere Marquette Railway had 12,227 employees and moved 2,449 million ton-miles of freight, or 199,959 ton-miles per employee. In 1928, although the number of employees had decreased to 10,258, the movement was 3,205 million ton-miles, or 312,528 ton-miles per employee, an increase of 56 per cent over 1920. This comparison is not complicated by any change of mileage, which was practically the same in both years.

This increase does not represent clear profit, as it was brought about by heavy expenditures for improvement in the railroad plant. While the greater part of such expenditures, amounting to $45,000,000, was charged to capital account, the operating expenses must bear that very considerable share which represents the cost of facilities retired. It is to be expected, therefore, that the operating ratio, or the percentage of operating expenses in terms of operating revenues, would not show as much improvement as the output per man. Such is the case on the Pere Marquette, where the operating ratio in 1920 was 90.98, or 34 per cent higher than in 1928, when it was 67.82. Some comparative figures for 1920 and 1928 are given in Table I.

In many ways the output of traffic units per man is a more satisfactory measure of efficiency than the operating ratio, especially over a long period of time, as the latter is affected by changes in rates, wages and prices of material. The uniformity of increase in efficiency on the Pere Marquette is shown in Table II, the fourth column of which gives the number of ton-miles of freight per employee. A still more accurate measure of efficiency is the number of gross ton-miles per freight-train-hour. This figure relates only to freight traffic and represents the product of the average trainload (including cars but not locomotives) by the average speed in miles per hour. It thus takes into account both the load handled and the rate at which it moves, and is not complicated by any factors relating to passenger traffic. The record of gross ton-miles per train-hour for 1920 to 1928, as given in the last column of Table II, shows an increase of 84 per cent from 1920 to 1928.

This very gratifying situation was brought about by the three factors which have made it possible for industry in general to increase its output per man—namely, (1) reduction of overhead, due to greater output; (2) increased efficiency of plant, and (3) increased efficiency of men. It is not possible to allot to each of these factors its actual share of credit, as they react on one another in such a way as to be mutually dependent. For example, some improvement, such as better track, heavier power or a new yard, results in faster service. This is taken advantage of by an efficient traffic department in the successful solicitation of new business, which

in turn reduces overhead cost per ton-mile. The increased volume of traffic then makes still other improvements desirable, and the round of increased production starts again.

Reduction of Overhead—As in a factory, a large share of the expense of operating and maintaining a railroad is independent of its output, so that an increase in the volume of business tends to reduce the unit cost. This share is probably larger in the case of a railroad than for most industries, as trains must be run and roadbed must be kept up, regardless of profit or loss.

TABLE I—DEVELOPMENTS ON THE PERE MARQUETTE RAILWAY

	1920	1928
Miles operated	2,234	2,244
Miles double track, operated	268	322
Miles all tracks, operated	3,155	3,713
Miles of 90-lb. rail; main track	545	819
Miles of 110-lb. rail; main track	0	130
Number of locomotives	448	418
Average tractive power	33,324	36,990
Average light weight, engine and tender, lb.	203,363	225,451
Net ton-miles per locomotive	5,466,500	7,655,344
Number of passenger train cars	379	323
Number of freight train cars	17,720	17,428
Number of work and company cars	369	607
Number of employees	12,227	10,258
Revenue passengers, thousands	4,404	933
Passengers carried 1 mile, thousands	236,637	95,198
Revenue tons, thousands	14,855	20,397
Increase, per cent		37
Gross revenue ton-miles, millions	2,449	3,205
Do. per employee	199,959	312,528
Increase per employee, per cent		56
Automatic block signals, miles	225	350
Automatic train control, miles	0	139
Operating ratio	90.98	67.82

On the Pere Marquette, the increase of 31 per cent in freight traffic from 1920 to 1928 no doubt had considerable effect in the better showing in the latter year, but it requires no extended analysis to prove that this effect was a much less important factor than the more efficient plant and personnel. Further, who can say how much of the increase of traffic was the result of general

TABLE II—OPERATING RESULTS ON THE PERE MARQUETTE RAILWAY, 1920 TO 1928

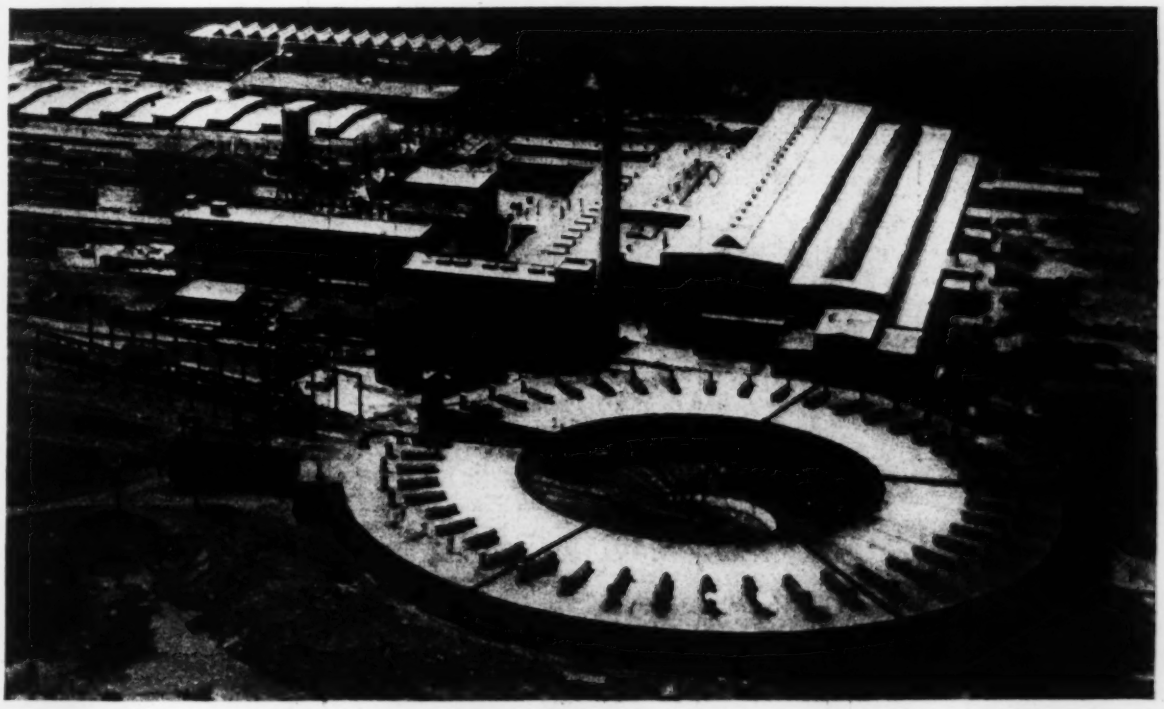
Year	Ave. No. of Employees	Net Ton-Miles of Freight, Millions	Net Ton-Miles of Freight Per Employee	Gross Ton-Miles Per Train-Hour
1920	12,227	2,449	199,959	10,820
1921	9,653	2,052	212,498	12,259
1922	9,389	2,286	243,485	13,026
1923	11,600	3,059	263,692	12,651
1924	11,085	2,796	252,209	13,928
1925	10,844	2,895	266,956	15,538
1926	10,852	3,045	280,594	16,728
1927	10,745	3,076	286,332	18,631
1928	10,258	3,205	312,528	19,865

conditions and how much was due to improved service, made possible by better facilities and increased effort on the part of the working forces?

Physical Improvements

Increased Efficiency of the Railroad Plant—Given a territory with an existing or potential traffic that is susceptible to the attraction of improved service, the betterment of a railroad's facilities is the first step toward earning dividends. For many years, however, the traffic available in Pere Marquette territory was limited, nor was the road financially able to make such betterments as were desirable. Its passing out of receivership in 1917 was soon followed by the period of federal control. At the close of this period in 1920 the expansion of the automotive industry was well under way, an extensive program of highway construction had been started in Pere Marquette territory, and the outlook for increased traffic from other sources was good. A program of betterment was begun and the following is a brief outline of its development during the nine years 1920 to 1928.

Extensions and Double Tracking—In 1921 and 1922 the Flint Belt Railroad, 8 miles long, was constructed along the easterly outskirts of the city of Flint to serve



ENGINE TERMINAL AND SHOPS AT WYOMING, MICH.
Note that roundhouse is almost a complete circle.

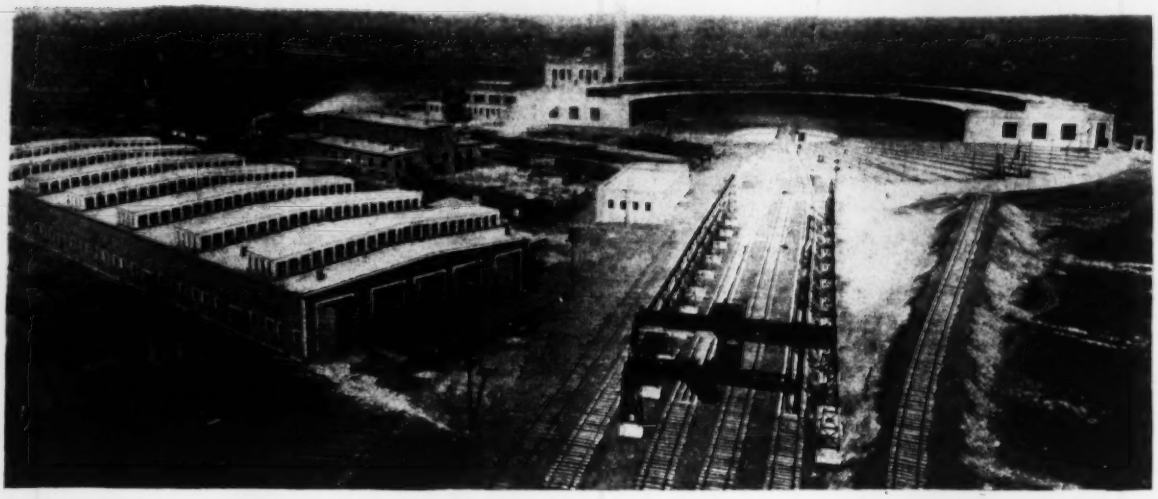
as a freight line for the Pere Marquette and to open new territory for industrial development. (See *Engineering News-Record* of July 5, 1923, p. 12.) In 1924, in connection with the construction of the new Ottawa yard near Toledo, Ohio, freight main tracks totaling 4 miles in length were constructed from the yard to two connections with the Toledo Terminal Railroad.

Grade and line changes during 1920-28 were made only in connection with double tracking. In 1923 second main track was built from Detroit to Plymouth, 20 miles, and at the same time several short westbound grades were reduced to 0.5 per cent. Second main track was built from McGrew to Mount Morris, 3.5 miles, in 1927, and a northbound grade of 0.5 per cent was reduced to 0.35 per cent, both in connection with the extension of the yard at McGrew. Several new passing tracks were installed and owing to the introduction of heavier power, a large number of existing passing tracks were extended. The use of heavier power made it necessary to rebuild four large steel bridges. About 1,000 lin.ft. of pile trestle was filled, and 52 plain timber trestles were replaced with creosoted pile and timber trestles with ballasted decks. Twelve highway grade separations were constructed, in most of which the highways were spanned by steel girders on concrete abutments.

Track Structure—Gravel ballast of good quality is available at several places on the Pere Marquette lines and has been used almost exclusively. In 1920 the use of washed gravel was begun and has been greatly extended. Of 820 miles of main track reballasted, the greater part was with washed gravel. In 1920 about 50 per cent of the ties in main tracks were treated, but by 1928 this had increased to 90 per cent. For a number of years treated ties have been used in all main track renewals. Creosoted ties are the present standard, but until recently the zinc treatment was used.

At the end of 1920 there were 545 miles of main track laid with 90-lb. rail. The use of 110-lb. rail began in 1927 and at the close of 1928 there were 819 miles of 90-lb. and 130 miles of 110-lb. rail. Mention may be made also of the interesting experiment with a concrete roadbed, designed by the writer, eliminating ties and ballast. (See *Engineering News-Record* of Dec. 10, 192[illegible], p. 958; Feb. 24, 1927, p. 312, and Jan. 26, 1928, p. 151.)

Yards and Engine Terminals—In 1920 a new 30-stall engine house with coaling station, water station, cinder pit, turntable and other facilities was built at Saginaw, Mich., and the facilities at Plymouth were improved by the erection of a fifteen-stall engine house turntable and coaling station. At New Buffalo, in 1921, the yard was extended by the addition of about 20 miles of track. A sixteen-stall roundhouse was constructed, together with modern facilities for coal and water, as described in *Engineering News-Record* of March 9, 1922, p. 407. The shops at Wyoming were enlarged and modern facilities installed in 1924 at an expense of nearly $2,000,000. In the same year the new Ottawa yard was installed north of Toledo, involving the construction of about 50 miles of track, a sixteen-stall engine house, turntable, coaling station, water station and ash-handling plant, at a total cost of $2,600,000. (See *Engineering News-Record* of July 8, 1926, p. 48.) In 1926 the Detroit yard at Oak was enlarged and car repair facilities installed, while the McGrew yard at Flint was enlarged in 1927 by the addition of 10 miles of track.



ENGINE TERMINAL AND SHOPS AT SAGINAW, MICH.
Ashpits and ash-handling plant in foreground.

Besides the water and coaling stations installed in connection with the above-mentioned improvements, a 500-ton coaling station was constructed at Ludington and one of 250 tons' capacity at Baldwin. A considerable number of water stations were replaced by those of modern type, and at many others steam pumps were replaced by electrically operated centrifugal pumps. The Pere Marquette is fortunate in having good water supply in most of its territory, but as certain points of large consumption are exceptions to this rule, a program of water treatment was begun in 1928 by the installation of a lime-soda treating plant at the Ottawa yard.

A part ownership in the Belt Railway of Chicago was purchased in 1923 by the Pere Marquette, which leased for its exclusive use a portion of the former company's yard at Rockwell and 72d Sts., in addition to procuring the right to operate over the Belt Railway to its Clearing yard and other points. In spite of a heavy decline in passenger traffic, the Pere Marquette has built eight new

passenger stations since 1920. Most of these are of brick and ranged in cost from $12,000 at Chatham, Ont., to $82,000 at Traverse City, Mich.

Automatic block signals have been installed on 125 miles since 1920, giving a present mileage of 350. In the same period, ten new interlocking plants were constructed and a number of old ones were rebuilt. Automatic train control was installed in 1925 on 139 miles between Detroit and Grand Rapids. Centralized control and automatic signals were installed in 1928 between Bridgeport and Mount Morris, 20 miles.

Developments in Equipment—At the close of 1920 the Pere Marquette was already well equipped as to motive power, having 448 locomotives with a total tractive power of 14,929,070 lb., or an average of 33,324 lb. However, many of the engines were old and not adapted to the requirements of the time. By the close of 1928 ten locomotives had been retired and 42 new ones purchased, including twelve passenger engines, ten freight and twenty heavy switching engines. These changes reduced the total number of locomotives to 418, but resulted in an increase of 3½ per cent in total tractive power and of 11 per cent in the average tractive power. At the end of 1920 the Pere Marquette owned 17,720 freight cars with a total capacity of 649,314 tons. At the end of 1928, through the retirement of the older units and the purchase of modern cars, the capacity had been increased to 700,033 tons, an increase of 7 per cent, although the number of cars had been reduced to 17,428, a decrease of 2 per cent. Its 1929 purchases comprise 1,000 automobile cars, 400 steel gondolas and 100 ballast cars.

Two new car-ferry steamers, each of 28 cars' capacity, were added in 1924 to the fleet operating across Lake Michigan from Ludington, making a total of seven vessels. This fleet will be again augmented in 1929 by two new twin-screw boats having turbo-electric propulsion. A new ferry of 27 cars' capacity was placed in the river service between Port Huron, Mich., and Sarnia, Ont., in 1927. These additions increased the total capacity of car ferries by 49 per cent, from 169 cars in 1920 to 252 cars in 1928.

Operating Performance—As a result to a large extent, but not wholly, of the above-mentioned improvements, the average movement per day per car increased from 16.2 miles in 1920 to 31.4 miles in 1928, or 94 per cent. The average speed of freight trains increased from 8.4 to 12.9 miles per hour in 1928, or 54 per cent. Only a small increase was made in average trainload, the tendency being rather toward greater speed. There was practically no change in average load per car from 1920 to 1928. With its small proportion of through traffic and its network of lines, the Pere Marquette's business does not lend itself to any considerable extension in length of engine runs. The number of net ton-miles per locomotive was 5,466,500 in 1920 and 7,655,344 in 1928.

Increased Efficiency of Men—After making all due allowance for the effect of heavier traffic and improved facilities, it is evident that an increase of 56 per cent in the output per employee cannot be accounted for by those factors alone, but that a considerable part of it is due to greater efficiency on the part of the working force; to more careful and intelligent planning and supervision on the part of officers, and to greater and better directed effort on the part of their subordinates. To have witnessed this growth, to have had a part in it, to have been at least in some degree its inspiration and guide, has been to me a source of the deepest satisfaction.

Improvements in the Imhoff Sewage Settling Tank

Submerged Settling Compartments With Top Slots Permit Scum to Rise to Enlarged Surface and Eliminate Foaming

By Otto Mohr

Director of the Deutsche Abwasser-Reinigungs-Gesellschaft, Wiesbaden, Germany

THE Imhoff tank is no doubt in widest use for the preliminary treatment of sewage. As is the case with many other devices, however, it has some disadvantages, shown by accumulating experience to be chargeable to the basic principle of the construction rather than to individual operating conditions. Naturally, many efforts have been made to remedy the disadvantages.

The efforts that have been made at the numerous Imhoff plants built in the Emscher district and the Ruhr Verband have already been fully reported; therefore the following remarks will be confined to those developments of the Imhoff tank which have been accomplished outside of these two districts.

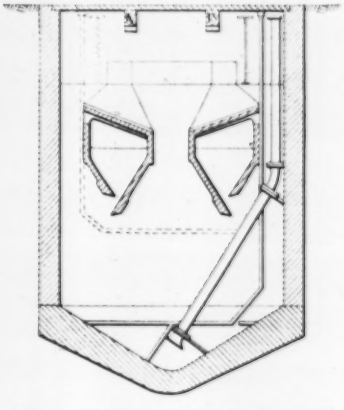


FIG. 1—IMHOFF TANK WITH SUBMERGED SETTLING COMPARTMENT—OMS SYSTEM

Scum Troubles—One chief source of trouble in the Imhoff tank arises from the fact that the scum remains in the sedimentation compartment, with results more or less harmful according to the nature of the sewage and the consequent nature of the tank action. The sludge, of course, passes automatically through the slot at the bottom of the sedimentation compartment, but the floating matter is not similarly removed; it remains in the sedimentation compartment and must be removed from time to time before it putrefies. This necessary cleaning is an inherent disadvantage in Imhoff tanks. In a few plants only is there an absence of floating scum, owing to the action of certain industrial wastes.

A secondary disadvantage arises from foaming and spitting. The rising gas-filled scum requires a certain area of surface to release its gas. But in the Imhoff tank of usual construction the surface area is reduced by the width of the sedimentation tank, leaving only two narrow strips of free liquid surface. This surface area is not always sufficiently large to allow the gas to pass off freely, and accordingly the sludge is not able to settle but is held up by the gas-filled scum rising from below. This is the basic cause of foaming. In extreme cases this trouble may be so serious that, as for example at Atlanta, even a raising of the wall 2.4 m. (about 8 ft.) was not sufficient to eliminate the trouble.

Because the sloping surfaces within the sedimentation compartment must be scraped frequently to remove the sludge and because the scum must be removed from time

to time, the clarifying efficiency of the tank is seriously reduced and material operating costs are involved.

Naturally, efforts have been made to eliminate these disadvantages and still retain the advantages of the Imhoff tank. Various attempts in this direction ultimately led to a new construction, in which the sedimentation compartment is submerged, as shown in Fig. 1. Just as in the Imhoff tank, this one has slots at the bottom of the compartment for the removal of the sludge, but it also—and this is the innovation—has slots at the top to permit the floating scum to pass out of the chamber. Thus all solids are removed automatically and hand operation is eliminated.

Because of the submerged compartment construction, the whole area of the tank is free for collection of scum, and thus foaming and spitting are eliminated. Experience proved that the entire tank surface gives sufficient area for complete release of the gas. It also developed, quite unexpectedly, that the shape of the compartment, with its steeper slopes because of the larger depth, results in self-cleaning of the sloping walls. In something like 150 plants of the submerged sedimentation compartment type that have been built within fifteen years, it has in no case been found necessary to clean the sludge from these sloping walls.

FIG. 2—TOP VIEW OF IMHOFF TANKS, WITH SUBMERGED COMPARTMENTS, SCHWERIN, GERMANY

Because of the shape of the compartments, also, more colloids are removed from the sewage than in an ordinary Imhoff tank. In tests for dissolved oxygen, the consumption of permanganate of potash by the clarified sewage is lower than in Imhoff tanks, which means that the clarifying efficiency is higher. All expectations have been realized in the actual operation of plants built with submerged sedimentation compartments.

Fig. 2 shows the plant of the city of Schwerin, Germany, where the Imhoff tanks were rebuilt according to this submerged compartment construction (known as System OMS). The city originally had six tanks, but the efficiency of clarification was too small and an offensive smell was produced, so that enlargement was contemplated. Instead, however, under the proposition of the writer's company, the city decided to rebuild the tanks as OMS tanks, with submerged sedimentation compartments. After the reconstruction the efficiency of clarification had been so increased that enlargement of the plant was not necessary, even though the quantity of sewage treated had been increased by the flow of some additional districts of the city.

Complete putrefaction of the sludge is obtained, and because of the elimination of hand cleaning as well as of foaming and spitting, smell is eliminated. The attendance has been reduced to one man in place of three or four men employed formerly.

At Amsterdam, an Imhoff tank of normal construction operates alongside a tank having submerged sedimentation compartments. Both were designed and built at the same time. The operating results of several years average as follows:

	Raw Sewage	Imhoff Effluent	OMS Effluent
Suspended matter	361.846	219	165.46
Chlorine	276.61	301.864	268.3
Permanganate consumption	296.69	295.46	274.24

The city of Singen, Germany, has two Imhoff tanks. In enlarging the plant two OMS tanks were built. Their operating results are given in the following table, from tests made Jan. 18, 1929:

	Raw Sewage	Imhoff Effluent	OMS Effluent
H_2S	Negative	Negative	Negative
Permanganate consumption mg. l	4,582	2,970	1,327
Chlorine		555	555
Settling test, c.c. /l	7.2	1.4	0.3
Total solids in effluent		1,470	1,406
Mineral solids in effluent		540	584
Loss on ignition		63.3	58.5
Solid matter in effluent		84	70
Mineral matter in effluent		26	29
Loss on ignition in effluent		69.0	71.8
Sludge	15.9% water; 84.1% solids 58.2% residue on ignition 9.2% loss on ignition		

Note: Temperature of inflow, 15 deg.; temperature of sludge, 14 deg.; temperature below water level, 8 deg.; pH value, 6.8.

A striking observation is that the new tanks demand less operating service than the old ones, and nevertheless show a greater clarifying efficiency.

At Siegburg there are two tanks with submerged sedimentation compartment alongside of one tank built similar to an Imhoff tank (Stiag tank). One of the OMS tanks has a colloid trap, while the other has no such trap. The former tank was deranged in its operation by wrong setting of the valves, which admitted too much water and therefore made the results valueless for comparison.

RESULTS AT SIEGBURG

	Raw Sewage	Stiag Tank	OSM Tank
Settling test, c.c. l	15	0.5	0.03
Permanganate consumption of filtered sewage, mg. l	1.043	0.917	0.825
Total solids, g. l	2.15	1.32	1.10
Residue on ignition	0.95	0.76	0.66
Suspended solids, g. l	1.584	.....	0.287
Residue on ignition	0.02	.....	0.020

Similar experiences were obtained at all other rebuilt plants. It will be readily understood from these results that a great number of cities have decided to replace their Imhoff tanks by OMS tanks, or else, in enlarging their existing plants, to add OMS tanks.

New Steel-Fabricating Plant for British Columbia

A contract for construction of the first unit of the Dominion Bridge Company's steel-fabricating plant at Burnaby, B. C., being erected to serve the growing structural steel requirements of the province, has been awarded to the E. J. Ryan Contractors Company, Ltd., for $1,500,000. It is understood the bridge company plans ultimately to spend $5,000,000 on this undertaking. Work on the 38-acre site will start immediately. Several buildings of steel and reinforced-concrete construction will be included in the first unit. The municipality of Burnaby has agreed to install a 12-in. water main and also, in conjunction with the city of Vancouver, to construct a 20-ft. concrete highway. The plant will be electrically operated throughout.

Problems Overcome in Building Approach to St. Louis Municipal Bridge

Railroad Tracks Beneath the Structure Were Continually Occupied With Cars, Which Taxed the Ingenuity of the Surveyors—Complex Steel Construction Necessary

By M. H. Doyne
Chief Engineer, C. E. Smith & Company, St. Louis, Mo.

The St. Louis municipal bridge is notable as an effort to regulate railway traffic in the city's interests. For many years all railway movements across the Mississippi River at this point have been over two bridges controlled by the Terminal Railroad Association of St. Louis, which thus controls all transfer movements between the numerous trunk lines on the east and west sides of the river. In order to provide competitive communication, the city planned a municipally owned bridge having both railway and highway facilities. But although the roadway of this bridge was opened for traffic in 1917, the track deck has never been used, since the city has been unable to get the railways to agree to relinquish or relieve the older facilities of the Eads bridge and the Merchants bridge.

The river spans of the municipal bridge were completed in 1912 and the west railway approach in 1913, but it was not until 1917 that the highway approaches and the eastern railway approach were finished. If the necessary traffic arrangements were made, the west approach would give access to the union station, the freight stations and the industrial district of Mill Creek Valley. But all these western connections are operated by the Terminal Railway Association, whose lines on the east side of the river have no direct connection with the bridge approach.

A southern approach to the west end of the bridge is the latest development, as described in the accompanying article. Until additional approaches are made on the east side to enable the Terminal Railroad Association to reach the bridge, the only railroad traffic expected to cross the municipal bridge is the freight and coal that moves between various trunk lines by way of the belt line of the Alton & Southern Railway on the east side and the Manufacturers Railway (a local terminal line) and the St. Louis Transfer Railway on the west side. This last-named road is a riverfront line owned by the city and operated by the Terminal Railroad Association, but under the terms of an ordinance of 1917 it may be used by any railway. Both the Alton & Southern Railway and the Manufacturers Railway have applied to the city for permission to operate over the Transfer Railway track for about a mile between the former road and the new bridge approach. Besides this, the construction of additional railway approaches on the east and an improved connection with the Mill Creek Valley district on the west are now under consideration by the city authorities and the Terminal Railroad Association.

—Editor.

MANY interesting and complicated problems entered into the design and construction of the new southern approach to the railway deck of the municipal bridge across the Mississippi River at St. Louis, as the approach passes through a closely built-up industrial district. This approach, completed recently and consisting mainly of a steel viaduct incline, connects the west end of the city's bridge with the Manufacturers Railway (a local line), the St. Louis Transfer Railway (a riverfront line owned by the city and operated by the Terminal Railroad Association) and also with the Missouri Pacific Railroad in its Lesperance St. yard. Fig. 1 is a plan of the bridge and its several approaches, while viaduct construction on the curved connection to the bridge is shown in Fig. 2.

Starting at the pier on the west bank, this southern approach swings to the left for 1,600 ft.; thence it continues for about 110 ft. on tangent and then along a 6½ deg. curve to the right for about 270 ft., beyond which it is on tangent to the foot of the approach incline. A compound curve at the upper end (Fig. 3) begins at 12 deg. and changes to 8 deg. and then to 5 deg. The 12 deg. curve was fixed by limiting side clearances and by provisions made in the existing steel of the west approach for this connection. Industrial plants, railroad tracks and other physical obstacles governed the general alignment of the remainder of the approach. Its total length is 4,700 ft., with a ruling grade of 2.1 per cent on the tangent, this grade being controlled by the connection to the yard tracks of the Missouri Pacific Railroad.

FIG. 1—ST. LOUIS MUNICIPAL BRIDGE AND RAILWAY APPROACHES

Difficult Survey Work—Much preliminary surveying was necessary before the final alignment was selected. Arrangement of supports to clear buildings and private property was a controlling element in the ultimate location, as may be seen from Fig. 3. Staking out the center line presented many surveying problems and taxed the ingenuity of the field party. On account of the freight houses and tracks constantly occupied with cars, and also on account of the many buildings and other obstacles, very few points could be located directly by running out the center line. It was necessary to set the points on the curved portion of the alignment from offset lines. Many small auxiliary traverses had to be run in order to check the accuracy of the work and to get the correct relationship between the various portions of the structure where direct measurements could not be made. This extra care in locating the supports was fully justified by results, as the steelwork fitted in place without any difficulty de-

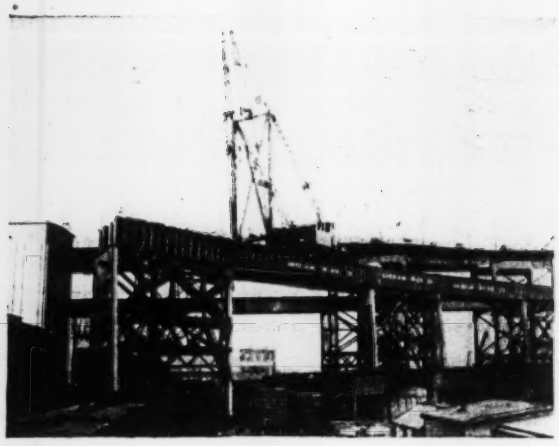


FIG. 2—NEW SOUTHERN APPROACH TO ST. LOUIS MUNICIPAL BRIDGE
Bridge in background has railway on lower deck and highway on upper deck.

spite the badly skewed bents and towers. Most of the approach was on property of the Missouri Pacific Railroad and considerable rearrangement of tracks was necessary.

Foundations and Concrete Work—Except for the interference due to railroad traffic, no unusual difficulties

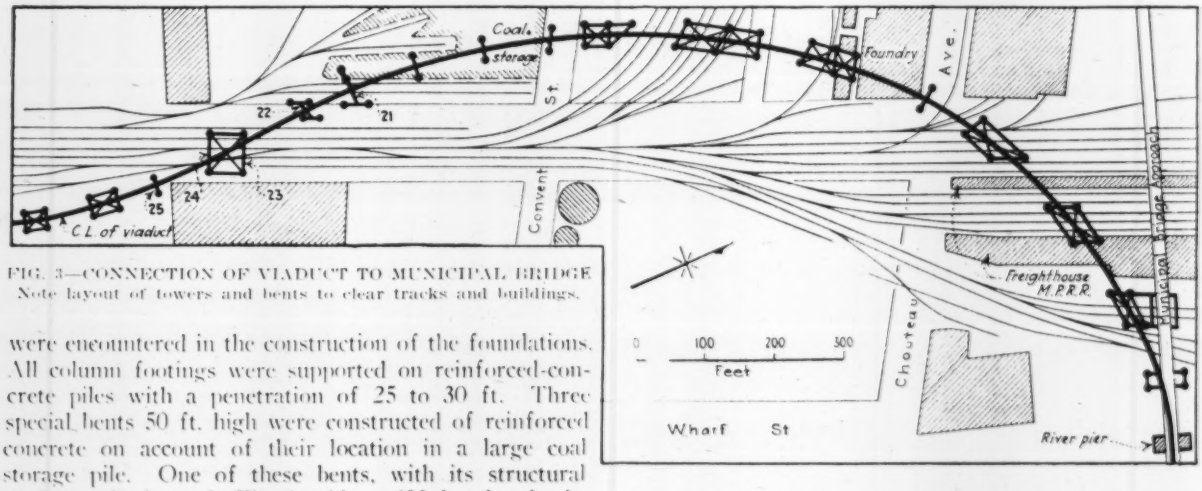


FIG. 3—CONNECTION OF VIADUCT TO MUNICIPAL BRIDGE
Note layout of towers and bents to clear tracks and buildings.

were encountered in the construction of the foundations. All column footings were supported on reinforced-concrete piles with a penetration of 25 to 30 ft. Three special bents 50 ft. high were constructed of reinforced concrete on account of their location in a large coal storage pile. One of these bents, with its structural steel core, is shown in Fig. 4. About 600 ft. of embankment is retained on one side by a crib wall built of precast reinforced-concrete units, this wall having a height of 3 to 20 ft. above the ground and extending about 3 ft. below the surface. Its toe is supported on a concrete block, no piling being used for the wall. The wall units and piles were cast at the site by the foundation contractor. Concrete mixed at a central plant and trucked to the site was used for all column footings and for the abutment. Concrete for the wall units, piles and concrete bents was supplied by the contractor's mixing plant at the pile-casting yard.

Special Steel Construction—The northern half of the structure includes deck-plate girders, deck trusses and through-plate girders. Its spans vary from 25 ft. to 117 ft. and are all skewed. Several bents with pin connections at top and bottom had to be used because of inability to get sufficient tower bracing at critical points, as shown by Fig. 5. In the right-hand view, the bent (No. 25 in Fig. 3) supports four girders at the north side and two through-girders at the south side. Limited side clearance made it necessary to cantilever the ends of the cross-girder to carry the through-girders. The southern end of the structure (on the tangent) adapted itself to standard viaduct construction with 70-ft. spans and 30-ft. towers.

An example of one of the special problems encountered is illustrated by the bent, No. 21, in the upper view of Fig. 6, which carries a 100-ft. through span and a 68-ft. deck span. Because of the surface tracks on which a locomotive crane must operate with top of boom 42 ft. above the ground, the columns had to be spread 40 ft. c. to c. With the very tall columns, it was necessary to brace the bent in the manner shown to provide for both lateral and longitudinal stability against traction and centrifugal forces in addition to wind and sway. The next bent, No. 22, also shown in the upper view of Fig. 6, is a badly skewed A-frame to permit a roadway to pass under the structure.

Immediately south is an almost square tower, shown by the lower view in Fig. 6, consisting of two bents (23 and 24 in Fig. 3) spaced 55 ft. c. to c. and having their columns 57.5 ft. c. to c. These bents span four busy tracks of the Missouri Pacific Railroad. The tower forms a table on which rest the 61½-ft. girders that carry the deck, these girders lying diagonally across the tower and the span being partly on tangent and partly on curve. A deck-truss span (Fig. 7) was found advisable in passing diagonally over a foundry building in which no supports could be placed. At the north end, the span is supported on a pin-connected bent at the curb line. One truss is 10 ft. longer than the other. Because of limited headroom, the depth of the trusses could not exceed

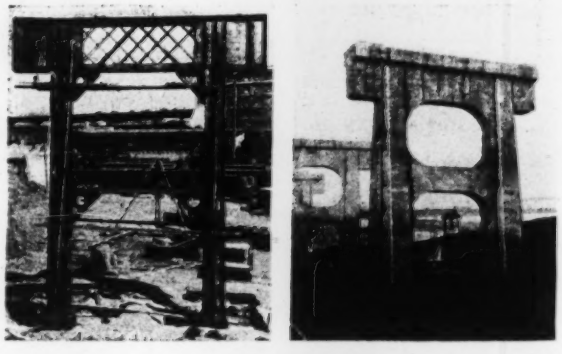


FIG. 4—CONCRETE-STEEL BENTS
At left—steel frame or core. At right—concreted bent. Three such bents will be partly embedded in the stock pile of a coal yard.

FIG. 5—PIN-CONNECTED VIADUCT BENTS
Note cantilever ends of cross-girders.

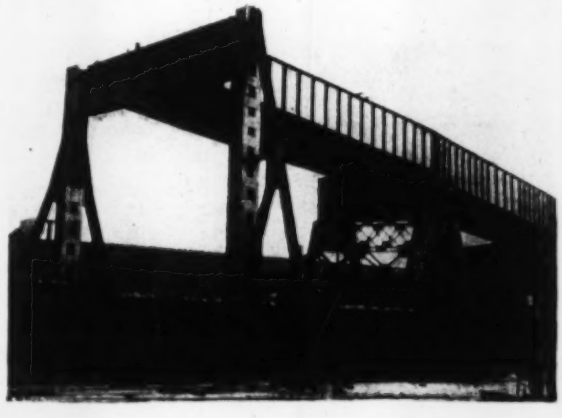
15½ ft. Temporary brackets on the columns, as shown, were used to assist the steel erection.

Treated Timber Deck—Tracks are laid with 100-lb. rails on open-deck construction consisting of ties and timbers of longleaf Southern yellow pine treated with mineralith or Wolman salts. About 1,000,000 ft. of lumber was required for the deck, walkways and hand railing. As the specifications required all timbers to be framed before treatment, framing details were prepared for all timbers along the tangent. But to follow this method for the curved portion of the approach was considered unwise, on account of the maze of detail due to curvatures, skews and grades.

To avoid the great expense of shipping those timbers to the job, framing them there, shipping them 125 miles to the treating plant and then returning them to the job, it was decided to reproduce the top flanges of the stringers for each span at the treating plant. This was done with timbers, two adjacent spans being laid out at one time to proper line and grade, making the necessary provisions for the variations in elevations of girder flanges due to variation in length of cover plates. Then the timber decking was laid out according to the track plans and was marked, framed, stamped for identification and treated. When these timbers arrived at the site they were assembled upon their respective spans in the order indicated by the numbers stamped upon their ends at the timber-treating plant. This method of determining the proper framing before treatment produced very satisfactory results, very little trimming being necessary in the field to make the timbers fit the steelwork.

Contractors and Cost—Foundation work and the approach fill were let to the Dunham Construction Company, St. Louis; steel fabrication to the American Bridge Company, and its erection to the Ben Hur Erection Company, St. Louis. The deck and track were installed by the Frazier-Davis Construction Company, St. Louis. A summary of cost is as follows: Foundations and filled approach, $162,000; structural steel erected, $720,000; deck and track, $190,000; rearrangement of surface tracks, $160,000; total construction, $1,232,000; right-of-way, $158,000; grand total, $1,390,000. Other incidental costs and engineering fees made the total cost of the project $1,500,000. Changes in surface tracks were carried out by the Missouri Pacific Railroad with its own forces at such times as the progress of work on the viaduct required.

FIG. 7—DECK TRUSS SPAN
Brackets on bent at left are for erection purposes.



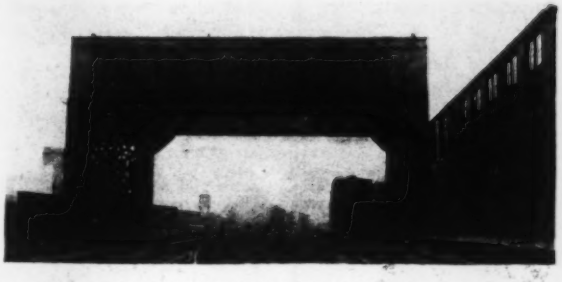


FIG. 6—SPECIAL VIADUCT CONSTRUCTION
Above—Bent at left has farther column braced longitudinally and bent at right is braced laterally; the next bent is skewed and two A-frames carry the cross-girder. Below—Two bents form square tower, across which the track stringers run diagonally.

Engineers—This project was handled under the direction of E. R. Kinsey, president of the Board of Public Service, St. Louis, with C. E. Smith, then head of C. E. Smith & Company (and now vice-president of the New York, New Haven & Hartford Railroad), as consulting engineer. The work was carried out under the personal supervision of the writer, with S. B. May in charge of surveys and design and F. R. Nohl resident engineer on construction.

An American Engineer Looks at Russia

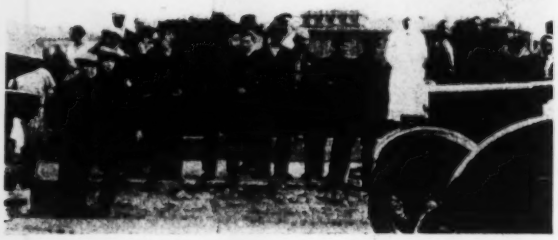
Opportunities That Are Afforded Outsiders to Take Part in the Development of the Country

By Lazarus White
President, Spencer, White & Prentis, Inc., New York City

AFTER several months of travel in Europe from Gibraltar to Hamburg, the writer joined a cruise to Scandinavia and Russia, which gave him the opportunity of spending one week in Leningrad and Moscow about equally divided. This, of course, seems a short time to form an impression of so vast a country as Russia, but the writer has tried to keep himself well informed as to events there and on the trip was accompanied by a lady who spoke Russian fluently and thus was able to obtain information at first hand. The official travel bureau of Soviet Russia, the "Intourist" agency, was most attentive to the party, and the week spent there was one of such intense interest that the impressions received were vivid.

Much has been written of the past of Russia, in the writer's opinion the best of all by that scientific writer Wallace in his "Russia." As to the present, much also has been written and much contradictory matter is being

FORMER PALACES NEAR THE NEVA, LENINGRAD
One of the few remaining droskies in the foreground. Note absence of traffic.



A CROWD IN LENINGRAD
Much interested in observing arrival of a party of tourists and new Ford autos. Note the dress of the Russians.

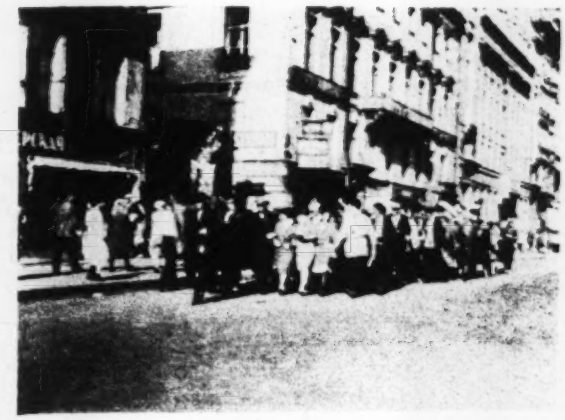
issued, accounted for largely by the bias of the writers and their attempts at propaganda either for or against the present government. Also, there is plenty of room for an honest difference of opinion among those who have no bias. Merely because of the vastness of the country and its manysidedness, the writer will not attempt to describe the present conditions except very briefly, but will endeavor to give his impartial impression as an engineer as to the future and the opportunities afforded in Russia to outsiders to take part in its development.

Briefly as to its present condition: Soviet Russia is in the position of a country abandoned by its people who have just returned to rebuild an about ruined civilization, not on old lines but on lines entirely new and with the aid of only a small part of the scientific and trained men of the old régime. The old civilization was antiquated and ramshackle and was almost completely ruined by war and revolution.

Now we have a condition where the rulers are earnestly trying to rebuild and modernize their country and are inviting the aid of outside economic forces to this end. Their ideal is not ours, but they recognize the virtues of our instruments of production, our technically trained men, etc., and are willing to employ them in the upbuilding of their country, with an ultimate ideal different from ours which it is useless for us here to pass judgment upon, particularly as it is likely to be profoundly influenced by the course of events, which the writer believes no one can predict with certainty.

To get an understanding of the economic development of Russia, the fundamental principle of the Soviet government will be given here as the writer understands it. It is based on the Marxist doctrine that "labor creates all wealth" and that consequently the services of the "entrepreneur," capitalist or "bourgeoisie" is unnecessary and in the nature of exploitation which reduces the worker, a "proletarian," to a state of "wage slavery." Therefore the Soviet leaders, in a sincere desire to

SQUARE OF WINTER PALACE, LENINGRAD
Dome of St. Isaacs in the distance. Note the roughness of rubble stone pavement and the absence of traffic.



PARADE OF WORKERS IN LENINGRAD
Demonstrating because of seizure of Manchurian Railroad by the Chinese. Many of those groups marched for hours.

establish their ideals, abolished all forms of private trade, manufacture, etc., where it was necessary to have employees. This made it necessary for the state to undertake all the functions performed elsewhere by private capital. An attempt was made to abolish all private property in land and buildings, but this was not practicable in the case of the property of the peasants or of the small landholders in the villages or cities. Small traders who do not employ help are allowed.

It will be seen that if the fundamental doctrine were strictly adhered to, there would be no inducements offered to outsiders to take up concessions; but certain modifications were made under the theory that as Russia was surrounded by capitalistic states and moreover was much impoverished by wars, external and civil, it could not exist as a pure communistic state, but certain concessions and compromises would have to be made so that later the communistic ideal could be realized.

A word as to the communistic ideal. This ideal antedates the principles of Karl Marx and is more ethical than economic. It is "from each according to his ability, to each according to his needs"—that is, each is to contribute all he can to the state or community and consume only that which is necessary to sustain himself. To this ideal the rulers and officials of the state are held.

The concessions to outsiders for the establishment of industries and the furnishing of expert services are in the nature of treaties between the state and private organizations or individuals, outside the ordinary laws, expiring in a limited time. This means that, after a period necessary to put Soviet Russia on a self-sustaining basis, the pure ideal of socialism and communism will automatically come into force. Such is the ideal of the United States of Soviet Republics. Whether it will be realized and when is not for us here to discuss.

What of the concessions offered? Is the government sincere in offering them? The writer believes that the government is sincere and wishes to have them taken up and succeed, and will give every assistance in its power.

The economic situation at present is that the government needs foreign credits to maintain its balance of trade and its monetary system. It is encouraging in every way tourist travel into Russia, is building up a travel bureau to take care of the tourists, to furnish guides, hotels, special trains, etc.

A CHURCH IN MOSCOW
One of a group in the Kremlin. It shows the Oriental influence in Russia.

WINTER PALACE, LENINGRAD
The former city residence of the Czar, now a museum. Construction is white stucco on brick.

The country obviously needs a speeding up of industry to provide the goods necessary for the people. A policy of extreme protection to home industries by means of high tariffs and control of trading by government monopoly has been built and as a result imported goods are dear and scarce. The policy of the government is to build up factories of its own to supply goods rather than secure them by import. It recognizes that the country's resources, abundant though they are in the way of pulpwood, lumber, petroleum and agricultural products, if exported are not sufficient to develop the necessary manufactures within a reasonable time; it therefore invites outside capital to come in through the agency of the concession.

How are the concessions likely to fail? This is a question so bound up with the future of the country and that of its present rulers that it is hard to answer. The

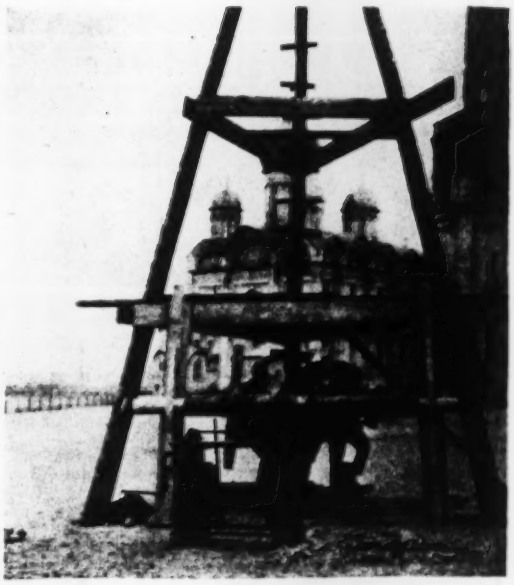
writer would not advise any company or individual to assume large risks in Russia, but he believes that large companies could well afford to set limited amounts aside for the purpose of taking up concessions so as to be on the spot as the country develops.

Russia is such a large country, contains such a large population and is so close to so many other countries that should it prosper those who come in now and aid in its development may reap large rewards in the future. Should the course of events be otherwise, then a loss which should be limited to what the company or individual can well afford will be sustained. But should a concession be taken up, it should be with the intention of staying by it patiently and not with the expectation of quick returns, as Russia will, in the writer's opinion, develop slowly.

Are Americans favored in Russia? Yes, very much so. The Russians always have been friendly to Americans and still are. There is no bitterness or animosity shown them. Although classified by them as "capitalistic," they regard America as a new country, similarly situated to themselves. The Americans are thought of as a new people, colonists who have developed a marvelous individual and industrial efficiency, of which they are in great need. They like the individual American, his free and easy manners, and will patiently and with good humor endure his brusque and, in the eyes of other Europeans, indiscreet ways. Therefore, Americans have the best chance to succeed in Russia and will not be handicapped by suspicion of being but agents interfering in their affairs.

There is a great lack of trained engineers in Russia, a deficiency which can best be supplied by Americans. Russian engineers, though few in number, are mostly highly trained theoretically, are good mathematicians and are capable of ably discussing an engineering paper, but because of a lack of practice and of isolation they are not usually capable of easily putting their ideas into practice.

The most promising form of concession in Russia is that of a contract for professional services with a firm of consulting engineers, the firm to supply trained men to advise the Russian engineers or superintendents, to lay out programs and to advise in a strictly consulting capacity; not to give orders directly to workmen, as owing to the totally different ideas of the Soviets this is impossible. Such a contract, as in the case of the coal and iron miners, has worked well for about two years. It is best for the engineer supplied to be under contract with the home firm and subject to recall in its judgment. It is likely to afford an attractive field for young engineers in good physical condition who love adventure.



PRIMITIVE DRIFTING RIG SEEN IN MOSCOW

GROUP OF GOVERNMENT OFFICE WORKERS IN MOSCOW

Is the lack of recognition of Russia by the United States a handicap to dealing with the United States of Soviet Republics? The writer believes not, as there are well-recognized agencies with which an American firm may deal. In some ways it may be an advantage, as the Soviet government is free of any suspicion of outside government interference and feels that it is dealing purely on a private and business basis. An American can easily travel in Russia, as his passport is exchangeable for temporary ones issued by the Russian government.

The writer would advise that all contracts with Russia be based on American money, as the value of the paper ruble is one of uncertainty and is bound up with the balance of trade and various economic forces whose future it is difficult to predict.

In the writer's opinion the most valuable aid which Americans give to the Russian government is in the field of construction—improving and developing the output and export of agricultural and mining products. This can be done by constructing roads and improving the railroads and means of transport. At present Russia seems to be almost lacking in improved highways, their roads being merely trails through the fields which must be almost impassible for long periods of time. Russia has vast forests suitable for pulpwood and timber, and because of the flatness of the country these are easily worked. At present a great deal of pulpwood is exported—in fact, at the port of Leningrad this seems to be the main product for export. An industry of pulp making could be built up.

In the cities, as well as the country, there is great need

of improved highways. Strangely enough, the old Czarist government, while building magnificent palaces and wide, imposing avenues, paved them in the worst possible way with cobblestones of the roughest sort—in Leningrad with wood blocks on a plank base.

In the cities there is a crying need for new housing to accommodate the growing city population, which is crowded into the antiquated structures of the old régime. This could best be done by the development of new suburbs, such as are being rapidly built in German and other European cities. The older buildings could then be demolished and their sites used for business purposes, parks and educational centers.

This question is very likely to arise, Why should we Americans, who have a very different ideal than that of the Russian Soviet government, take up concessions and thus contribute to its success? Of course, this is a question which cannot be satisfactorily answered in terms of prospective profits, but requires a deeper answer. The writer believes that no contract should be entered into unless there is *quid pro quo*—the service rendered should be fairly paid for, which squares accounts from the material side—"the laborer is worthy of his hire." On the other side, those who participate in the material developments of Russia may have the satisfaction of being the means, although not intentionally so, of bringing a great white country back into the family of nations, a country whose people have contributed and can to a still greater extent contribute to the culture of the world along lines of literature, music and art. All those who had the privilege of attending a concert in Moscow, given to the visiting Americans, were unanimous in stating that nowhere else in the world could their musical talent be surpassed. Their richness in folksongs and dancing was amazing.

Annual Cost of Metered Water in 21 Wisconsin Cities

THE annual cost of metered water in the 21 Wisconsin cities of over 10,000 population in 1920 is shown in the accompanying table, compiled by L. A. Smith, superintendent of water-works, Madison, Wis. Both domestic and industrial uses of water are covered, the former on the basis of 10,000 cu.ft. a year, passed through a ⅝-in. meter; the latter at 1,000,000 cu.ft. a year, through a 4-in. meter. Service charges, water charges and the two combined are given.

There is no service charge for either class of use in 6 of the 21 cities; one additional city has no domestic service charge, making 7 of 21. In three other cities there is no difference between the service charge for domestic and industrial consumers, and the charge made is nominal, at least for industrial consumption. Of the 14 cities making a service charge to domestic consumers, the range is from 50c. to $14.40 a year; correspondingly the annual industrial charge for 6 cities runs from 50c. to $259.20.

The cities are arranged by size of the annual domestic water bill, including the service charge. The range here is from $9 to $40 a year for a total consumption of 10,000 cu.ft. For industrial uses, 1,000,000 cu.ft. a year costs from $443.20 to $1,714.20.

Four cities have the same rank for domestic and industrial annual water bills, including service charges; 9 vary but little in rank in the two classes; a total of 13 out of 21 have identical or nearly the same rank in each class.

No data bearing on the range in annual water bills were supplied by Mr. Smith. As nearly as can be determined by *Engineering News-Record* all the cities in the list pump their water—about half from wells, the others mostly from lakes. How many filter the water cannot be stated, but apparently more of these are cities with low than with high annual charges. There seems to be nearly an equal division between municipally and privately owned works, with nearly all of the low-bill cities in the former class and most of the high-bill cities under private ownership. The significance of these figures is not fully apparent without data that are lacking, particularly as to relative charges for water supplied for fire protection and other public purposes—or in other words, data on how much of the burden entailed by public water supplies is met from general taxation, regardless of ownership.

TABULATION OF ANNUAL WATER BILLS

Wisconsin Cities Over 10,000 Population

City of Madison, Water Department, January, 1929

City	Population, 1920	Domestic Bill Based Upon 10,000 Cu.Ft. Through ⅝-In. Meter: Service Charge	Water	Total	Rank	Industrial Bill Based Upon 1,000,000 Cu.Ft. Through 4-In. Meter: Service Charge	Water	Total	Rank
Milwaukee	457,147	$2.00	$7.00	$9.00	1	$2.00	$700.00	$702.00	9
West Allis	13,765	1.00	10.00	11.00	2	1.00	1,000.00	1,001.00	16
La Crosse	30,363	.50	11.00	11.50	3	.50	480.00	480.50	2
Madison	38,378	4.00	7.50	11.50	3	40.00	551.25	591.25	4
Kenosha	40,472	.....	12.00	12.00	5	.....	608.00	608.00	5
Eau Claire	20,880	1.00	12.20	13.20	6	20.00	423.20	443.20	1
Wausau	18,661	1.00	12.50	13.50	7	20.00	619.00	639.00	7
Janesville	18,293	7.00	9.00	16.00	8	48.00	706.00	754.00	12
Manitowoc	17,563	.....	18.00	18.00	9	.....	640.00	640.00	8
Racine	58,593	.....	18.80	18.80	10	.....	1,154.80	1,154.80	19
Waukesha	12,558	.....	21.76	21.76	11	.....	761.76	761.76	13
Sheboygan	30,955	4.80	17.04	21.84	12	50.40	565.44	615.84	6
Beloit	21,284	5.00	17.00	22.00	13	48.00	670.00	718.00	10
Appleton	19,561	4.80	20.00	24.80	14	36.00	1,032.20	1,068.20	17
Green Bay	30,017	5.00	22.00	27.00	15	60.00	760.40	820.40	15
Stevens Point	11,370	2.00	25.30	27.30	16	8.00	520.80	528.80	3
Superior	39,624	.....	27.60	27.60	17	42.00	759.00	801.00	14
Oshkosh	33,162	.....	28.00	28.00	18	.....	736.80	736.80	11
Fond du Lac	23,427	3.00	25.00	28.00	18	20.00	1,080.00	1,100.00	18
Ashland	11,334	14.40	21.50	35.90	20	259.20	1,455.00	1,714.20	21
Marinette	14,610	.....	40.00	40.00	21	.....	1,307.00	1,307.00	20

New Subway for Buenos Aires

A concession to build a new subway in Buenos Aires, Argentina, has been granted to the Anglo-Argentine Tramway Company, according to dispatches received by the U. S. Commerce Department. This new line will link the Retiro and Plaza Constitution railway stations and will cross the city from north to south. Complete drawings have already been submitted to the municipality, and if they are approved, construction will be begun within a year. Construction of the underground railway to cross Buenos Aires from west to east, the concession for which was granted to the Terrocarril Terminal Central de Buenos Aires by a national law, is progressing rapidly on the section between the Federico Lacroze station and Calle Callao. It is expected that the first section of the system will be finished and ready for service by March, 1930. The total length of this system will be 5.5 miles and the total cost of the construction is estimated at 70,000,000 paper pesos.

Tests of Frame Wall Construction

Results of Experiments by Forest Products Laboratory Show Relative Merits of Varieties of Bracing

By George W. Trayer
Senior Engineer, U. S. Forest Products Laboratory, Madison, Wis.

MORE wood is used annually for the construction of frame houses and farm buildings than for any other purpose requiring manufactured lumber. Obviously, therefore, it is important to the economics of forestry and land use, as well as to the small house owner and farmer, that this great quantity of material be used to the highest degree of efficiency.

For these reasons the Forest Products Laboratory, in co-operation with the National Lumber Manufacturers' Association, is now making a special study of frame house construction. A series of tests is being carried on to determine the relative resistance of different types of frame wall construction to longitudinal thrust. Results of these tests afford quantitative evidence of the superiority of certain items commonly regarded as excellent, and they also bring out some unexpected results.

Since its early Colonial development on this continent the lumber-built dwelling, by far the most numerous class of building in use today, probably has never been subjected to a thoroughgoing engineering analysis. Spacing of joists and studs; methods of flooring, bridging and bracing; thickness of sheathing; framing over openings and around stairwells; tornado protective measures, and many other important points about a frame structure have been governed by tradition and carpenters' judgment.

Stud spacing of 16 in. is alleged to have been adopted because the first wood lath made were 4 ft. long. The maximum allowable deflection of 1/360 of the span, which governs most joist spans, was arrived at in the era of single floors and lime plaster on wood lath. It is computed on the basis of a uniform loading which the lumber-built dwelling at least never receives. The greatest floor deflection in residential buildings probably results from concentrated loads. Then comes the question: What deflection limitations are necessary to avoid plaster cracks, or do they occur independently of ordinary floor deflections?

FIG 1—PRACTICAL CONDITIONS APPROXIMATED IN TESTS

The answers to these and many other problems are matters rather of laboratory investigation and test than of mathematical analysis. Often the advantage of one or another method of construction is realized, but no evidence exists to establish the degree of such advantage. The news that a first step has been taken by the Forest Products Laboratory to establish such evidence, therefore, will be of general interest.

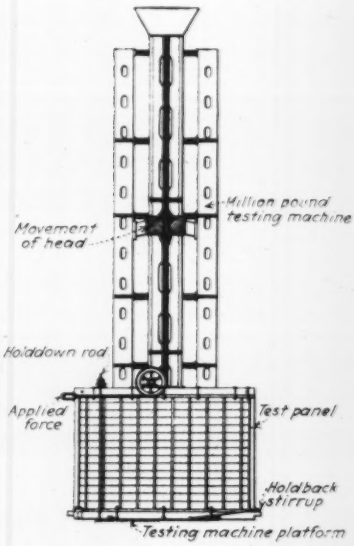


FIG. 2—DIAGRAMMATIC SKETCH SHOWING METHOD OF APPLYING LOAD TO THE TEST PANELS

Active work was begun by the laboratory early last fall, the first series of experiments being designed to show relative resistance of wall panels to longitudinal thrust. Examination of the results of several notable windstorms had indicated clearly that the resistance of typical lumber-sheathed frame walls to pressures exerted normal to the walls was apparently adequate for almost any condition likely to arise, and that the resistance against end thrust, such as occurs in walls when supporting surfaces are normally exposed to the wind, is the more critical factor of the two. Aside from the wind resistance, the matter of increased rigidity is of importance from the standpoint of keeping the house properly aligned, thus eliminating, or at least reducing, in a large measure endless annoyances and needless maintenance costs.

Room-Size Panels Used—Panels 9x14 ft. were selected as representative of story heights and of sufficient length to approximate practical conditions (Fig. 1). The lower or sole plate of each panel was firmly attached to a heavy timber and further anchored against thrust by a stirrup at the lower corner farthest from the application of thrust. By a variation of the customary set-up, horizontal pressure was applied to the upper corner of the panels in the direction of their length with the laboratory's million-pound testing machine (Fig. 2).

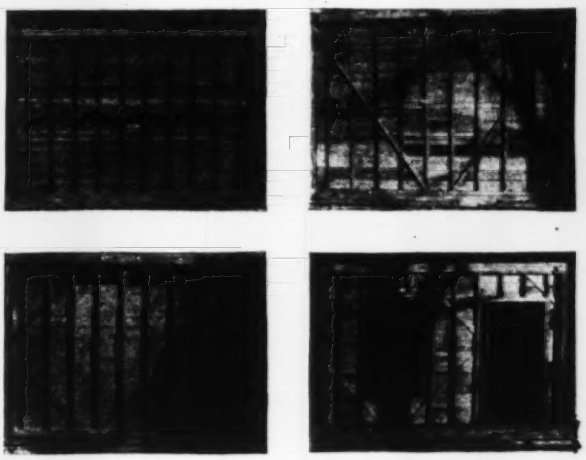
The panels were all framed with nominal 2x4-in. Southern pine lumber, carefully selected to represent the average run of the commercial grade and to avoid factors of inequality between those panels it was desired to compare. Sheathing and framing lumber were of No. 1 common grade, which is ordinarily specified for good frame construction.

The nailing of sheathing boards, their application to the panel frame—that is, horizontal or diagonal—the character of bracing and the effect of windows and doors cut into the panel all were tested. The stiffening influence of wood lath and plaster also were tested.

Merits of Bracing and Sheathing—One of the most interesting features of the preliminary tests was the comparison between the stiffening effect of horizontal and diagonal sheathing. Diagonal sheathing has long been regarded as superior in stiffness, but few or no data have been secured establishing its relative advantages. It was found that diagonal sheathing with two

nails at each stud crossing was two to four times as rigid as horizontal sheathing similarly nailed, depending upon the size and arrangement of the openings, the least difference applying to a wall pierced by window and door openings. It is good practice, therefore, to use bracing in horizontally sheathed walls to furnish the triangulation necessary to bolster up the stiffness. Accordingly, tests were made to bring out the relative merits of the different styles of bracing commonly used.

Diagonal or so-called herringbone bridging (Fig. 3) between studs contributes very little (30 per cent) to the stiffness of a horizontally sheathed panel, and since it is placed at mid-story height, it would appear that it might better be omitted from frame construction as a useless expense. The slight gain in stiffness from such bridging is interesting principally in connection with the fact that it has been widely advocated for tornado-resistant construction.



VARIOUS STYLES OF BRACING

Fig. 3—Herringbone bridging. Fig. 4—Diagonal bracing between studs. Figs. 5 and 6—Bracing outside of the studs. Fig. 7—Bracing around door and window.

Diagonal braces, 2x4 in., cut in between the studs (Fig. 4) added about 50 per cent to the stiffness of the panel, but 1x4 braces let into the outside of the studs (Figs. 5 and 6) increased the resistance to longitudinal pressure 150 to 300 per cent. Panels with door and window openings were less improved by such bracing than full panels, but let-in braces still proved by far the most advantageous (Fig. 7).

Two Nails at Each Stud Prove Satisfactory—It was found that using more than the customary and necessary two nails at each stud with horizontal sheathing is not worth the extra cost of nails and labor. In fact, three nails at each crossing of a stud did not increase the resistance to the applied loads, while four nails increased the stiffness only something like one-third. With diagonal sheathing there is a pronounced increase in rigidity as the number of nails at each stud crossing is increased. However, diagonal sheathing with two nails at each crossing of a stud makes such rigid wall construction that it is questionable whether the excess rigidity is worth the cost.

Wood Lath and Plaster More Rigid Than Sheating—Curiously enough, wood lath and plaster alone furnish greater rigidity to a wall than does any type of sheathing and bracing, and this applies to walls either with or without openings. Furthermore, the sheathing load at which plaster cracks begin to develop is about the same when lath and plaster are used alone as when used in conjunction with sheathing. The ultimate strength of the wall in the latter case, however, is increased. The concentration of stress at the corners of openings causes the development of plaster cracks at loads which are only 10 or 15 per cent of those required to produce the first cracks in a panel unpierced by openings.

The loads which come upon the frame are carried over to the rigid sheet of plaster in two ways: first, from the studs to the lath through the lath nails and thence to the plaster by friction, and second, but apparently the more important, by direct bearing of the plaster clinches against the studs. The plaster sheet can be effective only when the loads can be effectively carried over from the frame to it.

Seasoned Lumber Best—Absolutely green lumber is seldom used in good construction nowadays, but it is interesting that panels sheathed with green lumber and allowed to dry out had only about half the resistance to distortion as did the panels made of seasoned lumber. To a large extent wall stiffness is directly dependent upon the lateral resistance of the nails. Consequently it is to be expected that any working of the nails due to wetting and drying of the studs and sheathing would have a pronounced effect on wall stiffness. However, the accidental wetting of well-nailed wood sheathing is seldom a factor in reducing wall stiffness. A long period of wetting followed by drying would, of course, have a marked effect.

Vibration Tests—Sidelights on the effect of long-time exposure to wind impact, street traffic and other vibrating forces on a lumber wall were secured by mounting some of the panels on a machine table having a short horizontal throw. This machine originally was designed to disclose the effect of racking movements, such as are encountered in freight cars, on shipping containers. Panels were tested up to one million cycles with a movement of the table designed to produce deflections in the panel up to 50 to 75 per cent of its elastic limit. This vibration of the panels did not affect their rigidity or resistance to thrust as indicated by tests of matched panels.

Tests to Be Continued—The tests of large wall panels will be continued at the Forest Products Laboratory with a view of determining the merits of end-matched sheathing. A detailed report covering all phases of the panel tests will be issued by the laboratory at an early date.

No Increase in Texas Highway Funds

A proposed highway bond issue of $225,000,000 which was to have been submitted to Texas voters for approval was killed at the last session of the state legislature. Texas, for this reason, should not have been included in the list of states contemplating road bond issues published in *Engineering News-Record*, Sept. 12, 1929, p. 419. At the time the bonds were voted down, the gasoline tax was raised from 2 to 4c. per gallon, but as registration and weight fees were simultaneously reduced 50 per cent, it is estimated that highway funds for the year will show little increase.

Many Subjects Before Philadelphia Meeting Am. Soc. M. I.

Newer Developments and Problem of City Engineers, Airports, Regional Engineering, Traffic Relief and Utility Relations Form Bulk of Program

Engineering News-Record Staff Report

AIRPORT engineering, regional and city planning, rapid transit and utility relations, as well as the usual paving, lighting, sanitary and finance subjects, formed the main topics of the 40 papers and reports of the Philadelphia meeting of the American Society for Municipal Improvements, Oct. 14 to 18. Airports were covered by three papers, planning by six, utilities by three, transportation by two and paving by three. Water and sewage, as well as garbage, received attention in papers giving the results of much research and experience not hitherto available. For the first time public and private utility relations and the engineer's relations thereto were stressed. Paving and street papers took up the usual design, construction and maintenance operations, with lighting and traffic problems included. In following paragraphs abstracts and notes of the more salient features are presented.

Airports

Construction of 90,200 sq.yd. of asphalt concrete surface on the airport runways of the Columbus (Ohio) airport was completed in thirteen working days, according to R. H. Simpson, city engineer, in his paper on "Airport Runway Paving." The maximum laid in one day was 9,600 sq.yd. The haul was 9 miles and eighteen trucks were used. A 1½-in. asphalt surface was laid over a 5-in. concrete base. Grades were flat so that the drainage was at right angles to the 100-ft. runways, which had a 6-in. slope without crown. Gravel-filled trenches, 3 ft. wide, with tile at the bottom catch the water. Three lines of tile drain the subgrade, connecting to main cross-drains at frequent intervals.

L. A. S. Wood, manager, exterior lighting section, Westinghouse Electric & Manufacturing Company, enumerated the following points regarding the establishment, operation and maintenance of an airport: determination of class of technical assistance to be obtained from outside, whether to build by contract or by day labor, selection of someone to oversee the development, employment of an airport manager to direct operations upon completion, formulation of rules and regulations for use of the port, selection of a publicity manager, a maintenance crew and provision of housing and ground transport accommodations for passengers and pilots.

Regional and City Planning

Following a report by J. L. Cram, chairman of the committee on city planning, in which he recommended standards be set up for subdividers, Samuel Price Wetherill, Jr., president, Philadelphia Regional Planning Federation, reviewed the efforts of this tri-state organization in getting the movement under way. It is now well equipped with a budget of $150,000 and has developed confidence of the satellite cities so that the work can proceed with their co-operation. Development of adequate through highway facility is the principal activity, with the bypass idea uppermost. Recreation facilities in parks and forested ways along watercourses, development of navigation and protection of water supplies are also getting attention. Zoning is not stressed.

Francis J. Mulvihill, chief, division of city planning and municipal engineering, Pennsylvania Department of Internal Affairs, reported on planning progress in the state and in Philadelphia. About two-thirds of the population of the state is now represented by some form of planning body. Forty-three municipalities are protected by zoning.

Harold S. Buttenheim, editor, *The American City*, made a plea for spaciousness in working out the city plan. He quoted statistics to show that if spread more evenly population density is not so intense as it is believed to be and that foolish crowding by land developers should be curbed. S. R. DeBoer, city plan engineer, Denver, Colo., in his paper brought out the point that present requirements in recreation facilities call especially for active as well as passive activities.

Utility Relations

A. P. Learned, with Black & Veatch, consultants, Kansas City, in his paper on "The Relation of the Municipality to Its Utilities," brought out the following essential points with reference to necessary construction features: adequate and definite allocation of space in the street to avoid congestion, safe construction, definite recording and submission of plans to the city engineer. An enumeration was made of adequate services to be rendered by ten types of utilities.

"The Municipality and Local Transportation," a paper by Leslie Vickers, economist, A.E.R.A., contained a fair statement of the plight of the street railways, the obligation of city officials to permit this form of mass transport to function efficiently and some reference to the usual troubles of paving obligations, undue taxes and the millstone of fixed fares. He made a strong plea for co-operation in supplying a necessary service.

For only a year has the society had a public utilities committee, said G. J. Wagner, chairman. The greatest need is for city officials to realize the benefit of uniformity of action in handling utility affairs and the setting up of standards for both private and public utilities.

Municipal Finance and Legislation

How to get meritorious projects legally adopted and financed occupied large space on the program, more than one speaker emphasizing that this was the hardest part of the achievement of needed and wanted facilities.

In a paper on "Excess Condemnation," W. C. Bernard, valuation expert, St. Louis, Mo., courageously attacked the problem. He held it is a logical and desirable preventive of the waste of a basic commodity—land. Assembly of irregular parcels and resale under restrictions in keeping with the changed conditions after the improve-

ment are not only legitimate, he held, but give assurance that property adjoining a public improvement will early be put to the use to which it is best adapted.

The theory is that economy of land use can be made compulsory, as has been demonstrated in zoning. In answering the usual objections he stated that assembly of fragments for resale is purely a ministerial function incidental to the exercise of eminent domain, that the cities are already in the real-estate business, that it simplifies rather than complicates the legal process and that objecting owners are relieved of all speculation and financial risk. The only valid objection is when the land is used for purely recoupment purposes. To obviate the prejudice now surrounding the term, Mr. Bernard suggested changing the name to "marginal condemnation" or "extended eminent domain."

Along the same line was a paper by C. A. Howland, staff engineer, Philadelphia Bureau of Municipal Research, on "Trends in Legislation and Court Decisions Affecting Municipal Improvements," in which he stated that a marked change of liberality is taking place in the concept of public purpose by reason of the city entering fields more corporate than strictly governmental in nature. Sale of heat by central plants or in the form of coal is now upheld, but courts differ as to ice and many other commodities. Municipal airport construction is the latest function supported by the courts. By a peculiar evasion of the law in New Hampshire receipts of a community movie are used to build sidewalks. Police powers are becoming more numerous, control of subdivisions by city planning bodies being the latest. There is also a tendency against the rule of non-liability for negligence, such as purveying polluted water and causing damage by city-owned motor vehicles. Financing by the special assessment procedure is on the increase, with elimination of grade crossings recently added to the list. Prequalification of bidders, greater home rule and more uniformity are other trends noted.

Frank A. Marston, of Metcalf & Eddy, engineers, Boston, spoke of the growing practice of charging for sewerage service, six states having passed enabling acts (Ohio, Pennsylvania, Wisconsin, New York, Michigan and North Carolina). Four methods of charging based on the use of water are: graduated scales, a two-part rental including a step-rate and a ready-to-serve fee, a percentage charge added to or based on the water bill and a uniform rate for all water consumed. Charges are also based on the volume and character of sewage.

Railroad and Rapid Transport

The high-spot address of the convention which crowded the room to an attendance of more than 300 people was by Robert Farnham, chief engineer, Pennsylvania Railroad. His subject was "The Joint Terminal Improvements of the Pennsylvania Railroad and the City of Philadelphia," being a description of the work now under way looking to the abandonment of the Broad St. station, elimination of three unsightly bridges and provision of a new station across the Schuylkill River. For the latter he said 124 plans had been drawn and still more would follow. The ideal was for the traveler to find facilities where he expected to find them. The terminal is 140x375 ft. in plan and outside transport services have access on all four sides. Looking toward future use of air rights, foundations for future structures have already been put in. A power plant that can supply heat to the whole central business district is provided for in conduits and there is space for future units.

Transportation facilities for rapid transit in Philadelphia were described in detail by Charles H. Stevens, engineer of design, Department of City Transit, Philadelphia. In detail he described the proposed abandonment of the inner subway loop around city hall to afford space for an underground concourse around and through the city hall for pedestrians to make connections and interchanges at this highly congested spot without coming to the surface. In co-operation with the Pennsylvania Railroad the city plans to replace the Market St. elevated and subway bridge over the Schuylkill River by a tube and a subway. The southern end of the $100,000,000, 1¼-mile Broad St. subway is nearing completion, the north end being put into service in September 1928.

Traffic Provisions

E. A. Kemmler, highway engineer, Department of Public Service, Akron, Ohio, outlined the Akron program of progressive street widening which would cost $20,000,000, entirely out of the question as an immediate step by a city of 200,000 people. Progressive widening by setting back new buildings as the old ones become obsolescent was copied from a procedure used to widen Chesnut St., Philadelphia, from 50 ft. to 60 ft. initiated in 1884 and practically completed 30 years later. After the widening, Mr. Kemmler asks, "What next?" The essence of the problem, he says, is to keep traffic in motion and remove obstructions, meaning no-parking and grade separation. He demonstrated the economies of grade separation on the basis of 10,000 vehicles reaching an intersection from each of four directions getting a total loss of $70,800 per year, which, capitalized at 8 per cent for interest and sinking fund, would indicate that $885,000 was worth spending.

Sanitation

In the paper on "Sewage Treatment for Philadelphia," by John E. Allen, principal assistant engineer, Bureau of Engineering and Surveys, Philadelphia, it was stated that the ultimate solution indicated for the city would be the development of a process which he characterized as purely "mechanical," including partial aeration, sedimentation, the continuous removal of deposited solids, dewatering of sludge and incineration of the 5,000 cu.yd. of sludge daily to an ash bulk of about 15 per cent.

Answering the question as to why the manufacture of fertilizer was not considered, Mr. Allen stated that a market could not be found for the possible product, which would be loaded with trade wastes. With the present plan, the more oils contained the easier the sludge would burn. Methods for handling the sludge are not yet worked out, but sludge has been burned day in and day out.

The recommended program calls for works at three sites, handling 500, 200 and 400 million gallons daily respectively. Work to date has been confined to the northeast section, where a 60 million gallon daily capacity three-hour Imhoff plant has been installed. Pending the final decision as to method, work on pumping stations and intercepters and collection structures is under way.

Michael J. Blew, research engineer, Department of Public Works, followed Mr. Allen with a paper on "The Efficiency of Settling Tanks." Results of the experimental and full-size plants were given. Limits as to length of clarifier basins and other factors have been determined.

In a meaty paper on "The Dewatering of Screenings," Kenneth Allen, sanitary engineer, Board of Estimate and Apportionment, New York City, reviewed the practice and experience with pressing at Washington, D. C., Boston, Baltimore, Dallas, Borough of Queens, Milwaukee and Dayton. He concluded that proper pressing may be followed by burning. Wet screenings are not so successfully burned. Centrifuging is possible, he felt, but there is little experience.

L. R. Howson, consulting engineer, Chicago, and Langdon Pearse, sanitary engineer, Sanitary District of Chicago, discussed the two sides of the Chicago diversion case with particular reference to its sanitary aspects.

E. E. Butterfield, director of tests and specifications, Borough of Queens, New York City, reported on experiments made [years ago?] on the Elmhurst electrolytic sewage-treatment plant. These tests were run with and without lime and with and without current. Costs of electricity to get high efficiencies ran from $60 to $140 per million gallons, all beyond practical consideration, in his opinion.

Recent experiences with methods of garbage disposal were contained in the paper and report by S. A. Greeley, consultant, and his assistant engineer, L. B. Turner. Special note was taken of the stock-feed production processes used at Indianapolis and Kansas City, where the recent high price of grease had led to its extraction. The money returns at Indianapolis seem to exceed the cost, exclusive of interest, etc., by a small amount.

Lyle L. Jenne, sanitary engineer, Philadelphia Bureau of Water, in his paper on "Preliminary Purification Process of Polluted Water," gave comparative results of the pretreatment of the Schuylkill and Delaware river water by long-time sedimentation and prefiltration. He concluded that plain sedimentation for a week was as effective as sedimentation for shorter periods combined with prefiltration so far as bacterial reduction was concerned, but not for turbidity removal; turbidity can be removed, however, by coagulation.

Paving Papers

Julius Adler, consulting engineer, Philadelphia, read a paper on "Development of Brick Paving for Modern Traffic," in which he traced the return to asphalt filler and the trend away from the cement grouting popular a few years ago, which created a distinct partition between the lower or base slab and the upper rigid slab of grouted brick. The widest divergence of opinion relative to the form of bricks, he said, relates to the use of lugs, which he advocated. There is now a demand for a surface having the least possible amount of surplus asphalt on it after completion. Filling the joints with asphalt at 350 to 400 deg. F. "from the bottom up" is considered better practice than building up a mat on the surface with cooler material.

Developments in concrete street paving, said E. K. Smith, Portland Cement Association, are substantial forms more carefully set, a designed mix with materials proportioned by weight, adherence to the water-cement ratio, steadily increased use of central mixing plants and machine finishing, thorough curing and tests of strength, smoothness of surface and thickness. Curing concrete pavements by covering with asphaltic or bituminous material was discussed by Lee S. Trainor, district manager, McEverlast, Inc.

In the report of the committee on street paving and street design the chairman, Bryson Vallas, city engineer, New Orleans, called attention to the unsatisfactory methods of constructing paving in the steam railroad track areas. He recommended a special committee to meet with some recognized similar body of railroad engineers for the purpose of jointly working out a suitable standard. By resolution next year's committee was instructed to give consideration to the location of street-car tracks. Formerly, said John Klorer, president, A.S.M.I., the street car was the fast-moving vehicle, hence was placed in the center. Now it is the slowest, and consideration should be given to placing it along the curb to reduce accidents and eliminate the obstructions due to loading operations.

In street paving, specifications were presented for portland cement concrete foundations by J. C. McVea, chairman of the committee on subgrade and foundations, and for vitrified brick pavements by George F. Fisk, chairman of the committee on the subject. Before final adoption all specifications must be submitted to letter ballot.

C. L. Hawkins, chairman of the committee on street railway pavements and track construction, has been cooperating for several years with a sectional committee of the American Engineering Standards Committee. Specifications have been prepared for material to be used in the manufacture of special track work and the design of 7-in. plain girder rails for use in paved streets. Part of the work relating to 7-in. rails has been completed and adopted by several national societies. The part on the manufacture of special track work has been approved by the American Electric Railway Engineering Association and was recommended for adoption by the A.S.M.I. It will go to letter ballot.

Increase Forecast in Federal Expenditures

An investigation has been made as to the probable increase in federal government expenditures during the next four years as imposed by laws which have already passed Congress, and by other obligations which are practically mandatory. Increases imposed by existing legislation lie in four principal directions: in military expenditures, in public works, in the postoffice deficit and in farm relief. The growth of these expenditures, as imposed by present laws, is shown in the table. Increased naval expenditure is due to the expanded aviation, new cruiser construction and capital ship replacement programs. There is hope for some relief in this direction if there be a reduction in naval arms. Increased army expenditures are due to the aviation program and to rebuilding quarters. The normal postoffice deficit is increased by lower rates, increased wages and decreased hours of employment. Public works expenditures given embrace river and harbor improvements, flood control, the Boulder dam, public buildings, public roads, etc. This expenditure is more likely to be increased than to be decreased. It is impossible at the present time to schedule the volume of farm relief in annual amounts. The burden for the fiscal year 1930 will apparently be at least $150,000,000.

INCREASE IN FEDERAL GOVERNMENT EXPENDITURES

Fiscal Year	Army	Navy	Public Works	Post Office Deficit	Total
1926	267,300,000	312,700,000	170,800,000	39,500,000	790,300,000
1927	265,600,000	318,900,000	166,500,000	27,300,000	778,300,000
1928	293,300,000	331,300,000	183,400,000	32,100,000	840,100,000
1929	320,200,000	364,500,000	229,600,000	94,700,000	1,009,000,000
1930	341,800,000	399,200,000	275,800,000	84,000,000	1,100,800,000
1931	350,700,000	422,500,000	275,400,000	80,600,000	1,129,200,000
1932	348,900,000	452,000,000	264,900,000	80,000,000	1,145,800,000
1933	350,900,000	452,000,000	265,900,000	80,000,000	1,148,800,000

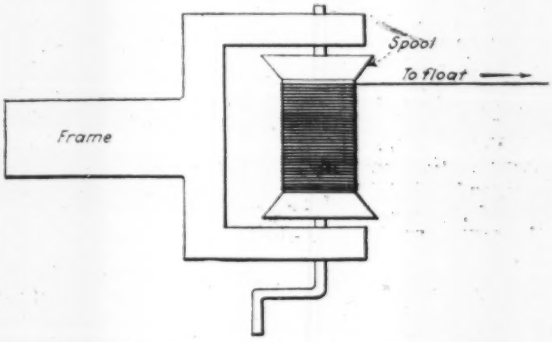
From Job and Office

Hints That Cut Cost and Time for the Contractor and Engineer

Streamflow Measured by Simple Method

By G. Goodwin
Price, Quebec, Canada

IN MEASURING the approximate flow of a stream, the usual method is to time floats over a certain distance along the channel. This requires two men, one to place the float, the other to time it when it passes a definite line. Errors are caused by eddies and cross-flow in the stream. Better results can be obtained by



REEL FOR FISHING CORD USED IN VELOCITY MEASUREMENTS

one man by the use of the following method: First, a line is stretched across the stream between two posts or trees upon which are marked division points for velocity measurement. Then, by wading or the use of a boat, the observer releases from each of these points a float to which is attached 100 ft. of common fishing line mounted on a simple reel, similar to that shown in the illustration, which can be constructed from an ordinary spool and a short piece of wire. By this method the exact time for the float to traverse an exact 100 ft. is measured and errors due to cross-currents are eliminated. Depth soundings and the calculation of volumes of water are made in the usual way.

Rock Asphalt Strip in Concrete Road Makes Permanent Center Line

By Joseph Pope
Pope Construction Company, Jefferson City, Mo.

IN DOUBLING the width of an old concrete road between Jefferson City and Louisiana, Mo., an unusual method was used to attain a better marking as a permanent guide to traffic. At a distance of 1 ft. from the old 9-ft. pavement a new strip of the same width was laid, and after the forms were removed, the clear space between sections was filled with concrete to within 1½ in. of the surface. This space was brought up to the general level with a filling of rock asphalt, resulting in a broad black mark down the center of the highway.

In laying the marking strip, the inside edges of the

ASPHALT CENTER LINE MARKS LANES IN CONCRETE ROAD

channel were paint-coated with an asphaltic cement paint. Gage strips of ¾-in. plank were laid flat and parallel with each edge of the channel, being held in place by 4-in. strips of galvanized iron tacked at each end and in the center of each plank and extending 1 in. below the bottom of the wood strip. These were hooked over the edge of the concrete to prevent lateral displacement. Rock asphalt was then dumped into the channel level with the top of the board and tamped by hand. After the boards were moved ahead, further hand tamping rounded the edges and, after several miles had been laid in this manner, a 5-ton roller was run over the mark, leaving the material smooth and at the same level as the concrete on each side.

Special Charts Simplify Design Problems

By R. C. Reese
The Building Products Company, Toledo, Ohio

WHILE the use of double contour line charts for the solution of problems in structural engineering involves no new mathematical principles, the method has not been generally adopted by engineers, although it is easy to apply and has many advantages which make it extremely useful in structural design. The alignment chart has many adherents, but it necessitates the use of a straight-edge, and the construction of such charts, particularly when logarithmic scales are involved, is rather tedious. The contour charts described herewith can, in the majority of cases, be reduced to straight lines by the proper selection of variables, and can therefore be easily constructed. Interpolation is easy, and the effect of varying one value is instantly apparent. Also, this form of chart provides a number of solutions for a given problem, so that the designer can choose the one most suitable for his case.

All engineers are familiar with the method of plotting a three dimensional figure, $x = f(yz)$ by assigning to z a series of increasing values and plotting $x = f(y)$ for each value of z. This is known as a contour chart. Another network of curves can be drawn for $p = \phi(m\,n)$

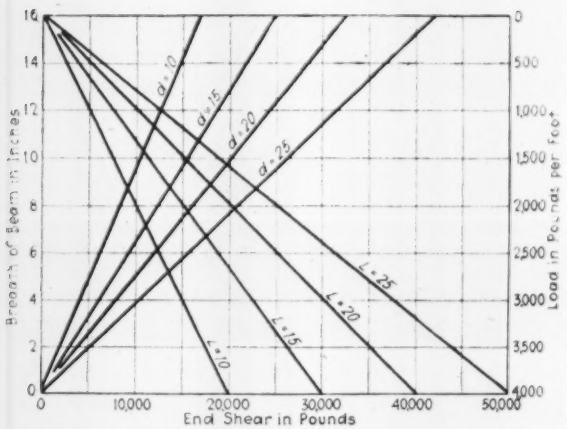


FIG. 1—GIVEN LOAD, SPAN AND BEAM BREADTH, TO FIND MINIMUM DEPTH OF CONCRETE BEAM

in the same way. By equating the values of x and p these two networks can be superimposed on the same chart, giving simultaneous values of y, z, m and n. In most structural problems it is possible to work the data into a form of a function of two independent variables equal to a function of two other independent variables in which the variables are involved only as the first power, or, at most, in parabolic form. For more complicated problems logarithmic scales can be used if desired.

In making up the charts care should be taken to arrange the two networks so that they do not interfere or come too nearly parallel. In general, it is best to have two origins at different corners unless the slope of the two sets of curves is such that they intersect better from the same origin. The choice of scales also requires a little study, as the doubling or halving of a scale frequently makes for improved appearance and better accuracy. Although it may seem paradoxical, in most cases the best place to start is with the function that is equated, which does not appear at all in the solution. This is the value shown at the top of the accompanying charts, given as illustrations of the method. These are not intended for designing as they appear here, as only a few of the contour lines are shown, the limiting conditions, stresses and other data are omitted, and the scale is greatly reduced.

Fig. 1 is used in designing the stem of a reinforced-concrete beam to keep the shear below a limit of 120 lb. per sq.in. The uniformly distributed load (right) and the span (sloping lines) determine the end shear (top). The breadth of the beam stem (left) and the effective depth (sloping line) determine the web resistance (top). Note that $\frac{7}{8} \times 120$ is used to allow for j. The diagram gives many combinations of breadth and depth for the solution of any one problem.

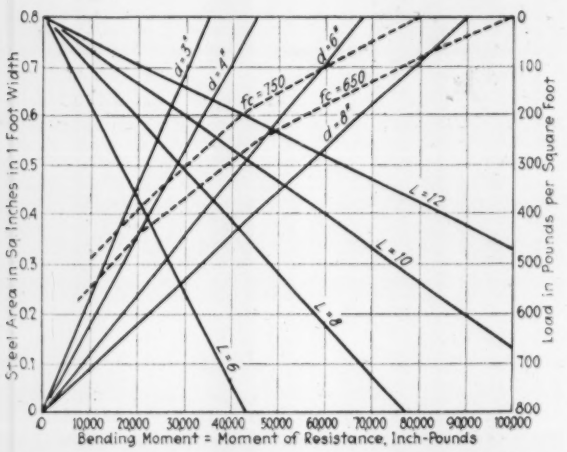

Steel Area in Sq. Inches in 1 Foot Width
Load in Pounds per Square Foot
Bending Moment = Moment of Resistance, Inch-Pounds
d = 5"
d = 4"
fc = 750
d = 6"
fc = 650
d = 8"
L = 12
L = 10
L = 8
L = 6

FIG. 2—GIVEN LOAD, SPAN AND SLAB THICKNESS, TO FIND REQUIRED STEEL AREA (CHECK CONCRETE STRESS)

Fig. 2 illustrates the design of a reinforced-concrete slab for moment. Resisting moment is equated to bending moment. Note that the span is used on the sloping lines instead of the load to avoid parabolic curves. This chart also illustrates the use of auxiliary lines governing a dependent variable. It is important to control not only the steel stress but the concrete stress as well, and this is taken care of by the dotted curves. These are plotted by determining for a given depth and concrete stress the maximum steel that can be balanced by concrete. The intersection of this steel area and effective depth determine one point on the f_c curve.

Besides the examples shown, diagrams for the solution of many other problems in structural design can be constructed. For more involved problems, the method can be extended indefinitely, using other origins and other pairs of functions.

From Job and Office

Hints That Cut Cost and Time

Temporary Struts Resist Arch Thrusts in Concrete Bridge Erection

IN BUILDING a five-span reinforced-concrete arch bridge across a small stream on state highway No. 10 in Oklahoma, temporary struts as shown in the accompanying illustrations were used in place of anchor piers. These struts, built on the line of thrust of the arches, were carried to rock. This method of construction was reported to work very satisfactorily.

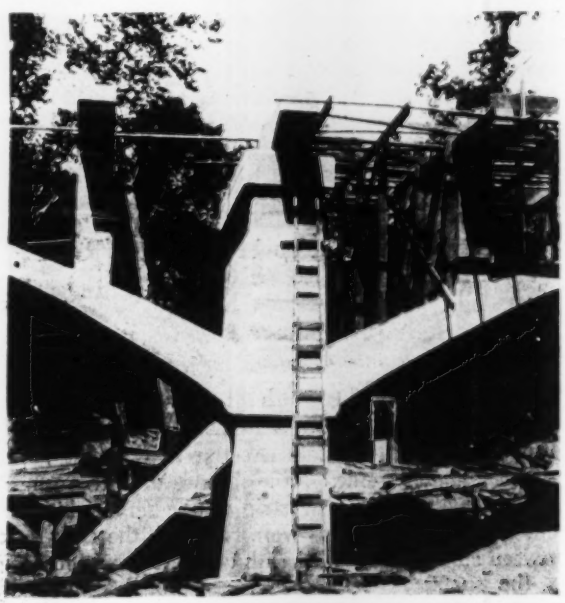


FIG. 1—PRECAST STRUTS RESIST ARCH THRUST DURING ERECTION

Photograph was taken just before the temporary struts were removed.

From Job and Office

For Contractor and Engineer

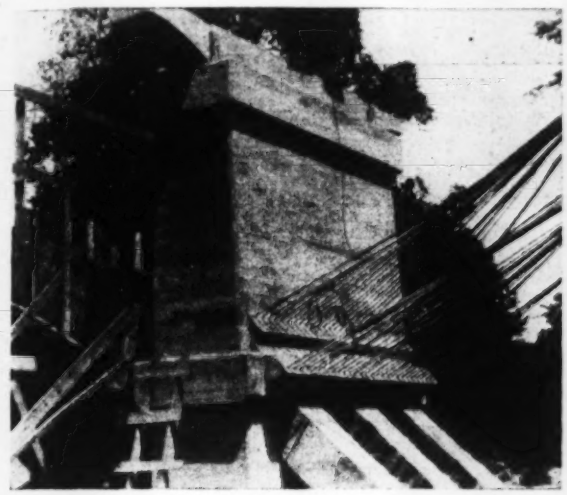


FIG. 2—STRUTS IN PLACE TO RESIST THRUST OF ARCH AT LEFT

Note rounded ends of struts to fit surface of pier. The construction joint at the springing line is also shown. These struts were used in the water as well as for the land arches.

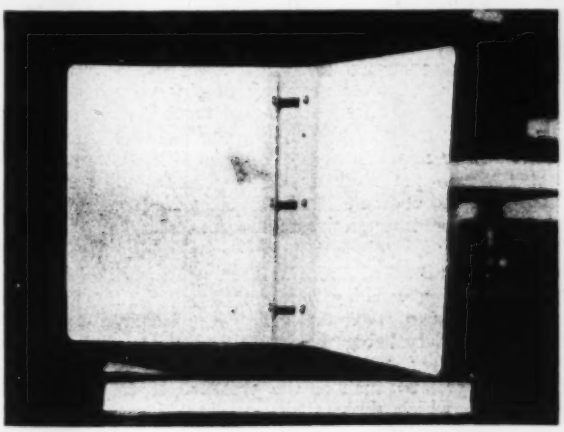
The contractors were the Flynn Construction Company and E. S. Alderman, of Oklahoma City. The bridge was designed in the bridge department of the Oklahoma State Highway Commission, under the supervision of W. C. Burnham, bridge engineer. W. C. Sale was project engineer on construction.

Standard Binder Devised for Filing Miscellaneous Data

By Ruth Canavan

Librarian, Metcalf & Eddy, Boston, Mass.

EVOLVED primarily to take care of computations and folded blueprints, a type of binder for material of non-uniform size and thickness developed by Metcalf & Eddy has also proved very satisfactory for binding the pamphlets and miscellaneous data which so often become misplaced in the engineering library. The binders consist of heavy mottled bristol-board covers 9x11½ in. with gray canvas backs and binding strips reinforced with the board. They are ordered with back widths of ¼, ½, 1 and 1½ in., the latter two sizes being most frequently used. Non-flexible backs were decided upon because they insure unvarying width of cover, bringing the backs of all binders into exact alignment on the shelves. As canvas takes drafting ink very satisfactorily, the backs are readily stenciled with a suitable title. Three holes conforming to those made by the hand punch used in the office are provided in the binding strips. The material is held in place by Chicago post binders with screw ends so that a pamphlet may be removed if desired, but not too easily. Pockets for maps, clippings and similar material are made of manila envelopes without the flaps, punched on one side and bound in the volume. Material in each binder is numbered from front to back, and a table of contents is placed at the end to facilitate adding new material up to the capacity of the binder.



BINDER FOR MATERIAL OF NON-UNIFORM SIZE AND THICKNESS

Cost of Jacking Culvert Through Fill Compared With Open Cut Method

By W. Mack Angas

Lieutenant Commander (CEC), U. S. Navy

A 48-IN. corrugated iron culvert 126 ft. long was jacked through a 34-ft. fill carrying a concrete highway at the Naval Fuel Depot, San Diego, at a cost of but one-third of that estimated for open-cut work.

FIG. 1—ARRANGEMENT OF JACKS AND TIMBERS IN JACKING CULVERT THROUGH FILL

Besides the advantage of lower cost, the jacking method eliminated interference with highway traffic or the necessity of a detour, which would have been practically impossible because of topographical conditions. The iron pipe replaced a 24-in. terra cotta culvert which had failed at the ends and was forced considerably out of round its entire length by earth pressures.

The pipe was jacked from the upstream side of the fill with the invert of the new culvert following both the line and grade of the old invert. The pipe sections, 22 ft. long, were riveted together from a trench dug

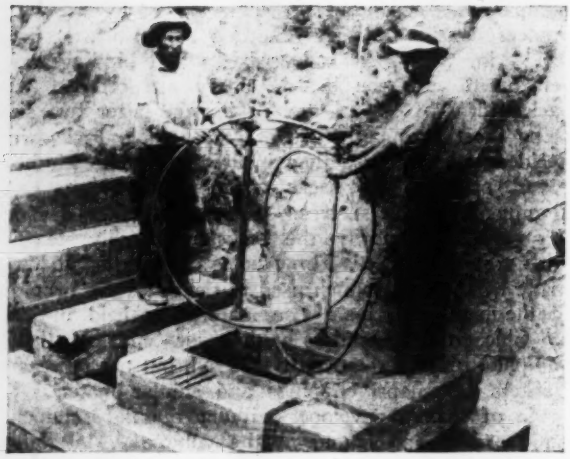


FIG. 2—HEADBLOCK, SPREADERS AND REINFORCING HOOPS USED IN JACKING OPERATION

Man at right standing on headblock. Reinforcing hoops clamped around pipe at jacking end to prevent distortion. Spreaders used in making lap joints of pipe sections.

at the toe of the fill to provide room for workmen. Spreaders, similar to trench jacks, assisted in lapping the joints. Two 50-ton hydraulic jacks were used with the timbering arrangement shown in Fig. 1. The jacking end of the pipe was protected by a timber head block and also by a steel hoop clamped around the circumference close to the ends.

Twelve eight-hour working days were required to jack the pipe into place by a crew consisting of a superintendent, two laborers inside the culvert excavating ahead as it advanced, one laborer removing spoil from the heading with a cut-down wheelbarrow, four laborers working the jacks and two carpenters assisting in the timber work. The excavation was kept a few inches ahead of the pipe, the upper section being semicircular with a radius $\frac{3}{4}$ in. greater than that of the pipe and the lower part of the excavation made rectangular. The corners between the pipe and the rectangular lower section of the excavation took care of any débris loosened or carried along by the passage of the culvert.

A comparison of the actual cost of jacking the pipe compared with the writer's estimated cost of placing by the open cut method follows:

Jacking Method	
Preparatory work, placing skidway, etc.:	
Supervision, 68 hours at $1.12½	$76.50
Laborers, 252 hours at $0.56½	142.38
Carpenters, 20 hours at $1.00	20.00
Actual jacking:	
Supervision, 96 hours at $1.12½	$108.00
Laborers, 632 hours at $0.56½	357.08
Carpenters, 16 hours at $1.00	16.00
Removing skids and cleaning up:	
Supervision, 8 hours at $1.12½	$9.00
Laborers, 48 hours at $0.56½	27.12
Timbers for skids, etc. 4 M. ft. b.m. at $40	160.00
Total actual cost	$916.08
Open Cut Method	
Supervision, 30 days at $9	$270.00
Excavation and back fill, 917 cu.yd. at $1.50 (hand excavation and removal by wheelbarrow)	1,375.50
Sheathing and shoring:	
14 M. ft. b.m. sheathing at $30	$420.00
3.4 M. ft. b.m. 6x8-in. wales at $40	136.00
1.2 M. ft. b.m. 4x4-in. struts at $30	36.00
Placing and removing sheathing and shoring, 18.6 M. ft. b.m. at $10	186.00
Temporary bridge:	
0.8 M. ft. b.m. decking at $30	24.00
0.9 M. ft. b.m. 4x12-in. stringers at $40	36.00
Labor on 1.7 M. ft. b.m. erecting and taking down bridge	34.00
Placing culvert, 126 ft. at $2 per ft.	252.00
Total estimated cost	$2,769.50

The work was done by H. H. Peterson, of San Diego. Capt. George A. McKay, Corps of Civil Engineers, U. S. Navy, was officer in charge of the contract, with the writer as project manager on the job.

Job and Office Notes

IN CONSTRUCTING a modern concrete road near Altoona, Pa., it was decided to loosen without removing an old surface of tar-bound macadam, which was broken up to an accurately determined depth and then rolled to receive the new concrete surfacing. The old pavement was dug out with a flat-bottom skimmer bucket, which lifted the depth of material to be displaced and dumped it back upon the road surface. Samuel Domenick, Altoona, Pa., was the contractor.

IN HANDLING ROCKY EXCAVATIONS with clamshell buckets fitted with teeth, considerable difficulty is often caused by rocks, particularly those known as "one-man" size, sticking in between the teeth and holding the buckets partly open. This not only reduces the capacity of the bucket but often requires a man to be placed at the dumping point with a bar to pry the rocks loose. We found on a recent job that by removing one or more of the teeth this trouble was overcome. The wider space between the remaining teeth permits most of the rock to enter the bucket without impairing the digging efficiency of the clamshell.—H. C. CHARLES, *Waterloo, Iowa.*

Letters to the Editor

Chart for Beam Design

Sir—I regret very much indeed to be obliged to call your attention to an error in the presentation of my diagram for the conversion of concentrated loads on beams to equivalent uniform loads (*Engineering News-Record*, Oct. 10, 1929, p. 586). If you will consult my original manuscript, you will read "P = concentrated load; a = distance to P from the nearest support." This was published "a = distance to the uniform load from the nearest support," the joke being that there is no uniform load. The same error appears in the caption of the drawing.

ERNEST MCCULLOUGH,
Consulting Engineer.

Long Island City, N. Y.,
Oct. 12, 1929.

Method of Placement an Important Factor in Checking Percolation Through Dams

Sir—In your issue of Aug. 8, p. 204, is a description of the Bull Run storage dam for Portland, Ore., furnished by B. E. Torpen, who was superintendent of design and construction on the project. In your editorial, same issue, you properly compliment the engineers and contractors on this structure for their carefulness of effort.

In the same issue is an article by N. A. Bowers, your Pacific Coast editor, on the subject, "The Effect of Percolating Water on Concrete Dams," which strongly draws attention to the absolute necessity of obtaining a watertight concrete if permanence in such structures is to be hoped for. An engineer experienced in this class of construction will himself have appreciated the truth of Mr. Bowers' remark that " . . . the methods of placement rather than the quality of the concrete itself are more frequently the cause of percolation through hydraulic structures." This fact is very strongly brought out in the report of its studies issued by the committee of the Engineering Institute of Canada which has been working for several years at the University of Saskatchewan under the ægis of the Research Council of Canada, its duty being the investigation into means for insuring permanence in concrete structures under adverse conditions, especially such as the presence of sulphates in the soils upon which these structures are placed. This committee has definitely proved that percolation through concrete of waters that may be practically free of salts in solution will in time destroy the concrete.

Reverting to the article by Mr. Torpen and with particular attention to the diagram shown on p. 208, it will be observed with regard to successive pourings or placings of concrete in the dam:

First, that the surface of each be designed to lie normal to the resultant force adverse to the dam. This means that at the toe of the dam the surface of the placed concrete is to be some 15 ft. higher than the corresponding surface at the upstream edge. This result can be obtained only by the use of very dry concrete or by the use of small barriers at intervals across the structure and is hardly practicable with a "slump" of 3 to 4 in. mentioned on p. 207 as characteristic of the concrete unplaced. If the concrete had been sufficiently dry to maintain this extraordinary difference in elevation in each mass of concrete placed, then it is questionable whether watertightness could be obtained without an extraordinary amount of labor in rodding and ramming, which work, even with dry concrete, would make the maintenance of such a slope almost impossible.

The second point noted concerning these serial masses of concrete is that "before starting a new pour the surface was cleaned up after the carpenters and given a slush coat of grout. Following the grout two batches of concrete without cobbles were placed to make a bed for the regular concrete."

The writer would not permit this treatment of a set concrete surface for the receipt of new concrete. The grout becomes sufficiently dry to form a polishing skin upon the set concrete, effectively separating rather than bonding the successive masses. An effective wetting of the set concrete after the laitance *and an inch or two of porous concrete beneath the laitance has been removed* will permit immediate placing of regular concrete in such a manner as to bond the two bodies together.

The history of the theories of concrete making and placing has shown engineers of America in 1900 or thereabout placing very dry concrete in an effort to insure strength only; from about 1905 onward for some years a much wetter grade of concrete was the fashion, a practice not discouraged by the contractor who was endeavoring to fill the forms at minimum cost. Conscientious engineers endeavored to insure dense bodies of such concrete by puddling and ramming, the best of them removing the laitance from each layer before placing fresh concrete, but forgetting that the exudation of this laitance was concommitant with a porous and low-strength layer of concrete immediately beneath it; furthermore, not always did the most careful inspector or engineer succeed in obtaining a surface sufficiently rough and clean to make probable the cementing of successive layers.

FIG. 1—CONSTRUCTION JOINTS SHOW AS DEFINITE PLANES

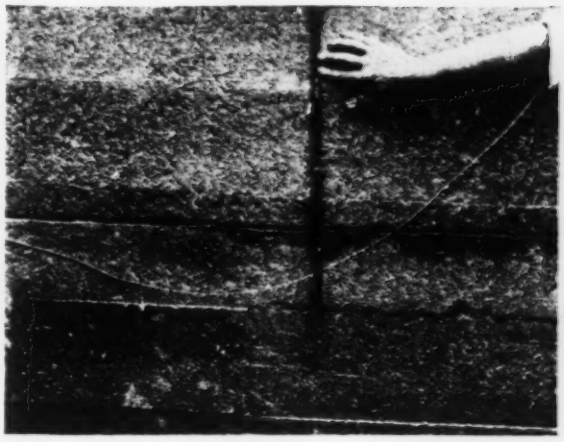


FIG. 2—CONSTRUCTION JOINT ON DOWNSTREAM FACE OF DAM

It was not until the last fifteen years that there has been a general recognition of the influence of the water-cement ratio in combination with a proper minimum slump which must be observed in order to get such concrete as designs call for. With this recognition came the elimination of any considerable quantity of laitance on the top of a concrete mass properly placed. Education on this matter is rapidly extending into the ranks of the contractors, superintendents and foremen.

The accompanying illustrations are exceedingly educative on the points above discussed. They show (Fig. 1) a cross-section of a weir built in 1909 on the Winnipeg River at the hydro-electric plant of the city of Winnipeg, of which construction the writer was acting chief engineer. This concrete of sand and gravel with crushed stone and about six bags of portland cement per cubic yard was mixed and placed with every precaution known to the profession at that date; it was slightly too wet for modern practice, and as a result not only were the surfaces of successive placings rather level than irregular but considerable laitance rose on each day's work. This laitance was carefully removed to a depth of 1 or 2 in., the surface was swept and washed and a neat cement grout was placed upon the cleaned surface over the area of a set of forms 50 ft. long.

During the winter season of 1924-25 during a period of low water in the Winnipeg River, the upper pond level was maintained at or about the crest of the weir, no water being wasted past the power plant. As a result a sheet of ice 2 ft. or more thick was formed upon the pond and exerted such a thrust against this weir as to shift the upper 8 ft. to a maximum of $\frac{3}{4}$ in. downstream. The dam was sheared along a construction plane for a length of nearly 500 ft. The structure was reinforced by building an 8-ft. extension upstream with the crest at 30 deg. below horizontal. About 100 ft. of the weir was removed and a set of heavy sluice piers was built, the date of the other work being convenient for complying with the requirements of the dominion government that greater river discharge capacity should be furnished at this power plant.

The taking of the photograph reproduced as Fig. 1 was possible because of the preparation for the sluices, and in it are shown three distinct planes at the elevation of the top of successive pours made in 1909. Inspection of the surfaces shown at the botton of the photograph proved the cement grout above mentioned to have caused a distinct plane of separation, and this surface was distinctly glossy.

In Fig. 2, showing the downstream face of the weir, may be seen the intersection of such a plane with the exterior

face. In spite of the existence of these construction planes there had been no evidence of percolation through the wall prior to the shearing caused by the thrust of the ice sheet of the previous winter.

I trust that these observations may be of some help to those members of the profession engaged in the construction of hydraulic works. W. G. CHACE.

Winnipeg, Man.,
Sept. 28, 1929.

Engineers and Architects

Sir—In *Engineering News-Record* of Oct. 3 on p. 519 appears an editorial relevant to architects and engineers and their status under the provisions of the multiple dwelling law. The said editorial is, in the opinion of the writer, most untimely, for it has completely missed the point in question. It is difficult to believe that *Engineering News-Record* wishes to lend itself to any movement tending to deprive a considerable part of the engineering profession of its livelihood and the public of proper protection. I wonder if the author of the editorial is familiar with the problem and with the fact that many engineers are prevented from continuing a practice to which they have devoted a lifetime and a career.

Many of the most important structures of this city, state and nation have been designed by and the plans filed by engineers. There are neither laws nor ordinances in this city requiring the approval of the esthetic features of buildings, except public ones, upon which the Municipal Art Commission passes judgment. The existing laws and ordinances are concerned with the protection of life, health and property and not with ornamentation. Furthermore, there is not a single architect in any department passing upon plans submitted. In the building bureaus engineers only examine plans. The same is true in the Fire Department and the Board of Standards and Appeals. The Tenement House Department employs men called examiners, many of whom are engineers, but none of whom is an architect. The functions of this department, however, are confined to matters pertaining to light, air, courts, yards, passageways, etc., as required by the law, and it is in no way concerned with architecture or appearance.

Is the author aware that in the interests of the engineering profession and at the insistent appeal of many engineers, not alone of this city but of the entire state—for the law is optional in cities outside of New York—the New York State Society of Professional Engineers, through its Metropolitan Conference, has brought action to test the constitutionality of section 300 of the said law and that the matter is now pending in the Supreme Court? Does he realize that counsel for the commission which drew the law has offered to try to revise the act; that he, as well as the Tenement House Commissioner, Building Department heads, numerous architects throughout the state, legislators and other interested parties have openly expressed themselves to the effect that a mistake has been made? Does he know that a society of registered architects has offered the services of its members pending a modification of the law? Does he realize that men who prepared and filed plans for structures already erected cannot now file plans for foundations, retaining and bearing walls or any other alteration for the same buildings; that if it was decided to install dynamos, chemical plants, electric heating systems, elevators, towers, tanks or, in fact, to carry out any phase of strictly engineering practice in an apartment, club, hotel or multiple family dwelling the engineer cannot file a plan for it, whereas an owner or an architect may? Of what value is the privilege of designing and of preparing plans if they cannot be filed and corrected by the man who makes them? Does anyone believe for a moment that a man can carry on a practice if his clients know he cannot file plans?

As a matter of fact section 300 is an absurdity. Architects and engineers alike realize it. The two strictly professional societies representing these callings in New York are striving to work harmoniously in the interests of both professions and of the public, and the discriminatory section 300 was not the result of the efforts of the New York Society of Architects, but rather of persons ignorant of conditions.

Retaliation and preventing architects from practicing certain phases of engineering are neither possible nor desirable. If one will take the trouble to investigate, one will find that the architect is permitted by law to practice what is called architectural engineering and that 50 per cent of the requirements for registration as an architect in this state comprehends a broad field of engineering knowledge. If architects have been designing steel frames or foundations, they must be permitted to continue, as that involves a fundamental law of a right to a livelihood they have been making when a law was enacted. The unfair part is that an engineer is not eligible to qualify, even through examination, for registration as an architect unless he has worked as an apprentice for an architect. This is fact, not theory, for the writer knows of several who, though highly qualified through training and experience and willing to submit to examination, have been refused the right to take the examination that would qualify them to continue to do what they have been doing for years. As a result these men are summarily deprived of a livelihood.

The publication of such an article, in the most prominent engineering journal of the country at a time when the court has the matter under advisement is hardly in keeping with propriety and could do much injury to the profession which the journal represents. ARTHUR V. SHERIDAN,

New York City, President New York State Society of
Oct. 15, 1929. Professional Engineers and Land Surveyors.

The editorial in question was written with no intent to influence the court decision in the test case on section 300 of the multiple dwelling law. It was written to demonstrate that the provisions of section 300 did not degrade engineers to the status of subordinates of architects. Whether section 300 limits the right of certain engineers to continue to earn their livelihood or otherwise violates the Constitution was not under discussion. That is the question now before the courts. —EDITOR.

Progress in Car-Ferry Railway Links

Sir—In regard to Mr. Kent's letter in *Engineering News-Record* of Oct. 10, p. 588, it may be pointed out that there is a confusion between car-ferry routes and car-ferry steamers. The article referred to car-ferry routes on Lake Michigan, of which there are nine, as stated. Of these, the Grand Trunk Railway has one, the Pere Marquette Railway has three, the Ann Arbor Railroad has four and the ninth is operated jointly by the Michigan Central Railroad and the Duluth, South Shore & Atlantic Railway.

Chicago, Ill., Oct. 14, 1929. CAR-FERRIES.

Explosions of Sewer Gas

Sir—From the several reports I have seen of the disastrous explosion of sewer gas at Newburgh, N. Y., on Sept. 16 (see *Engineering News-Record*, Sept. 19, 1929) it seems to be the general opinion that it was caused by pressure in the sewers due to an exceptionally high tide, forcing the gas into cellars, where it became ignited.

The mean tidal range at Newburgh is 2.7 ft. and that of spring tides 3.3 ft. With an outlet exposed at extreme low tide and all openings in the sewer closed, the pressure developed at high stages of the tide might have been sufficient to force unventilated traps in the house drains. But it might be interesting to know (*a*) whether house drains are trapped in Newburgh and the traps ventilated and (*b*) whether manhole heads are perforated and the holes clean or clogged.

With the omission of traps on the house drains, or if the traps were ventilated, and with unclogged perforations in manholes, the theory of back pressure due to the tide as the prime cause would seem to be untenable.

The explosion is but one in an increasingly long list calling attention to the necessity for more adequate control over the admission of gasoline and other volatile oils into sewers. KENNETH ALLEN,

New York, N. Y., Sanitary Engineer.
Sept. 23, 1929.

News of the Week

Pennsylvania R.R. to Improve Line Through Baltimor

Announcement is made by the Pennsylvania Railroad that an agreement has been reached with the city of Baltimore that opens the way for complete electrification of the road from New York to Washington. The agreement covers extensive station platform and track improvements in and through Baltimore and the construction of two new double-track tunnels in the city limits. Actual work on the Baltimore improvements will be undertaken immediately and will be completed within five or six years, by the end of which time, it is expected, electrification will be completed between New York and Washington.

Public Land Commission Named by President Hoover

President Hoover has announced the names of those who have accepted appointment to the commission to study the feasibility of turning surface rights in public lands over to state control, a proposal the President made to the Governors of public land states some weeks ago. The commission will have representatives from all the states affected, and other sections of the country will also be represented. There will be about twenty members, two of them women.

Those who have accepted are: Elwood Mead, California; I. M. Brandjord, Montana; R. K. Tiffany, Washington; Rudolph Koechler, Arizona; Charles J. Moynihan, Colorado; George W. Malone, Nevada; William Peterson, Utah; I. H. Nash, Idaho.

James R. Garfield, Secretary of the Interior under President Roosevelt, will be chairman of the commission. General representatives who have accepted appointments are: George Horace Lorimer, Philadelphia; former Governor James P. Goodrich, Indiana; W. B. Greeley, former chief of the bureau of forestry, Department of Agriculture; and Gardner Cowles, Des Moines, Iowa. The remaining members of the commission will not be named until the President returns to Washington from his Western trip.

San Gabriel Dam Site Declared Unsafe by Board

Work Suspended on $25,000,000 Structure Pending Action on Special Report—No Sound Rock Found at West Abutment

EXCAVATION at the San Gabriel dam site near Los Angeles has been stopped as a result of a report by a board of consulting experts which states "that a safe dam of the proposed height cannot be built at this site." The board consisted of L. C. Hill and A. J. Wiley, consulting engineers, and R. T. Hill and C. F. Tolman, geologists, and was appointed to review the foundation conditions disclosed by excavation following a slide of about 200,000 cu.yd. of material which occurred Sept. 16 during stripping of the west side of the site. Pending final consideration of the report and further investigation, exploration work in tunnels and shafts will be continued by the district. The state engineer has visited the site and is to make an independent investigation of conditions.

The substance of conclusions reached by the consulting board's report is given in the following: Exploration indicates that the height of the dam will exceed similar existing structures by 150 ft., and the resulting stresses call for concrete and foundation rock of best quality. The diorite at the site will form a suitable foundation when not crushed by faulting or weakened by weathering and rock exposed at the east abutment is satisfactory, with the exception of minor defects that may be cured.

Excavation at the west abutment has failed to reach sound rock, and exploration tunnels and shafts indicate that "sound rock would not be reached at any reasonable depth, if at all." Faults revealed by exposures and borings strongly indicate a continuous fault zone near the downstream toe of the dam approximately parallel to the axis, and a well-defined northeastward fault near the heel of the dam; these intersect in the area of the west abutment and are the reason for the broken and crushed condition of the rock here.

Failure of the proposed dam, should it occur, "would probably be sudden and the consequent loss of life and property enormous." Study of the condition shows definitely that a safe dam of the proposed height cannot be built at this

LOUISVILLE MUNICIPAL BRIDGE TO BE OPENED OCT. 31

Although the first contract for the construction of the $4,750,000 bridge across the Ohio River at Louisville, Ky., was not awarded until June, 1928, the structure is almost completed and will be opened to traffic Oct. 31. The total length of the main bridge is 3,740.5 ft., including two 820-ft. and two 500-ft. spans. Approaches add 2,008.9 ft. to the length. Two 38-ft. roadways and two 6-ft. sidewalks are provided. Costs were allocated as follows: financing and interest during construction, $662,969.12; real estate and property damage, $435,594.02; contract construction cost, $3,574,773.14; administration, $76,663.72. Bonds issued by the city of Louisville to cover the entire construction cost will be paid off from toll collections, after which the bridge will become free. Ralph Modjeski and Frank M. Masters are consulting engineers on the bridge, with C. Glennon Melville as resident engineer. Contractors are the American Bridge Company for the superstructure, the Vang Contracting Company, Pittsburgh, for the substructure and the Henry Bickel Company, Louisville, for the approaches.

location. Further exploration to determine the possibility of a dam of less height should be carried on, and in addition a study of other possible sites to give necessary flood control is recommended.

Following the reading of the report at the meeting of the Los Angeles County board of supervisors, under whose direction the dam is being built, it was taken under advisement and the contractor was ordered to stop all construction work pending further investigations. The San Gabriel dam is a part of the Los Angeles County Flood Control District program; the total cost of the project is estimated at $25,000,000, of which amount about $3,000,000 has been expended up to the present time.

Sacramento Defeats Bond Issue for Water Supply

Failure of the voters of the Sacramento (Calif.) Municipal Utility District to approve by the necessary two-thirds majority the proposed $11,600,000 bond issue to build the Silver Creek project to bring from the mountains a domestic water supply resulted in defeat of the measure at a special election held Oct. 10. A heavy majority was polled in favor of the measure, but it was not sufficient to carry it.

California Contractors' License Law to Be Enforced Nov. 1

Rigid enforcement of the new California contractors' license law, which went into effect Aug. 15, will be carried on after Nov. 1, according to Registrar James F. Collins, of the department of professional and vocational standards, which has direct supervision of the act. The law, sponsored by the California chapters of the Associated General Contractors, provides that every contractor operating within the state must obtain a license which is issued upon the submission of a statement of the general nature of the contractor's business, giving the names of the members of the contractor's corporation. The act is not one of prequalification, for it provides that a license must be given to every applicant. Public utility corporations and public bodies doing their own work are exempted by the terms of the law. The licenses must be renewed June 30 each year. It is required that all licensees shall report changes of personnel and addresses within 30 days after they occur. A complete indexed record of all applications and all licenses issued, and of all renewals, terminations, cancellations and suspensions, will be open for public inspection.

Any person, firm or other organization may file a duly verified complaint with the registrar charging that a licensee is guilty of one or more of the following acts or omissions: (1) abandonment of any contract without legal excuse; (2) diversion of funds or property, received under express agreement for use on a certain contract, to the application or use for any other contract, obligation or purpose with intent to defraud or deceive creditors or the owners; (3) fraudulent departure from, or disregard of, plans or specifications in any material respect without consent of the owner or his representative or the doing of any willful, fraudulent act by the licensee as a contractor in consequence of which another is substantially injured; (4) willful and deliberate disregard and violation of building codes of the state or of any political subdivision thereof, or of the safety laws or labor laws of the state. On the filing of such complaint, the registrar shall investigate the charge and within 60 days after the filing of such complaint shall enter and file his decision with his reason therefor. If the registrar's decision be that the licensee has been guilty of any such acts or omissions, he shall suspend or cancel the contractor's license. The contractor may petition the registrar for rehearing, and if denied, may appeal to the Superior Court of the state. An appeal automatically restores the license until final decision is made. Any contractor operating without a license within the state will be subject to a fine of $500 or six months imprisonment, or both. James F. Collins, the registrar, is a past-president of the state realty board, and has been actively engaged as an engineer in construction work for the last 25 years.

Conflicting Testimony Given in Floodway Suit

Possible Additional Flooding of Land in Boeuf Area Essential Point to Be Decided—Injunction Asked

THE BOEUF floodway injunction case of Kincaid vs. United States was taken under advisement Oct. 19 by Judge Ben G. Dawkins after a trial lasting four days. The decision will determine whether or not a permanent injunction shall issue restraining the construction of the Boeuf basin floodway.

For expert testimony, the government and the complainant placed four engineers on the stand. Considerable diversity of engineering opinion developed among the opposing witnesses, and, to a lesser extent, among the government engineers themselves. Engineers testifying for Kincaid were J. P. Kemper, New Orleans; L. T. Berthe, Charleston, Mo.; Harry Jacobs, state engineer of Louisiana, and J. R. Adams, member of the Board of State Engineers of Louisiana and for many years in charge of levee work. Testifying in defense of the plan were: Capt. John Paul Dean, on whom the government relied as to the engineering details of the Boeuf floodway; Major Ernest Graves, member of the Mississippi River Commission; Gen. T. H. Jackson, president of the Mississippi River Commission; and Edgar S. Maupin, civil engineer in the employ of the government.

Aside from the engineering testimony, witness after witness for the complainant testified that the sale and loan value of the land in the proposed floodway had been practically destroyed by the prospect of the floodway.

According to the engineers for the complainant, Kincaid's land would get more water under the adopted plan. Captain Dean testified to the contrary. He had made the calculations on which the army engineers' estimated frequency of once in thirteen years for a stage of 60½ ft. at Arkansas City was based. The question of whether the land would receive additional flood waters, referred to in section 4 of the flood-control law, is the essential issue of the case, the court stated.

The complainant's engineer witnesses were in general agreement as to the effect the floodway would have on his land. Using discharge figures of the Mississippi River Commission, they furnished evidence that the adopted plan would bring additional floodwaters to the land. With a flood like that of 1927 at least 900,000 sec.-ft. of water would pass over the fuseplug levee at Cypress Creek and down through the floodway; this is at least 350,000 sec.-ft. of floodwater more than the amount which passed through in 1927.

Captain Dean, on direct examination, said that flood levels on the plaintiff's land would be no greater under the adopted plan than in the past. Cross-examination brought the admission that, under maximum flood conditions contemplated in the Jadwin plan, water on Kincaid's property probably would rise to a depth of 16.4 ft. on the highest point, as compared with 4 ft. on the highest point during the high water of 1927. His first statement, it then was learned, was made only with respect to the effect the guide line levees in the State of Louisiana would have. The fuseplug sector and the levee to close the Tensas basin are both in Arkansas, out of the jurisdiction of the court in which the case was on trial.

In contrast to the landowner's picture of the floodway as a designed diversion from the Mississippi channel, Captain Dean referred to it as a natural passageway. "The waters pass naturally as they always have passed down through the natural Boeuf basin. Without the guide levees the waters would pass down the Boeuf basin in exactly the same manner as they have passed with the guide levees in existence." Referring to the guide line levees, he said: "These levees are built to protect the adjoining lands. They are not built to guide the waters to any particular place." The admission that water would reach a depth of 16.4 ft. on Kincaid's land was made only after a rigid cross-examination.

Major Graves supported Captain Dean's estimate on flood stages, but said the frequency was a surprise, and he thought it quite possible that the 1927 flood would prove to be a 25- or 50-year peak. Mr. Kemper had testi-

fied that with building up the levees on the main channel and contracting the channel, a flood stage of 60½ ft. at Arkansas City would be reached once every four years. On the basis of discharge observations shown by the tables of the Mississippi River Commission, he said, had there been no crevasses, this stage would have been reached and the Cypress Creek levee overtopped in 1912, 1913, 1916 and 1927 (probably not in 1922), or once in four years average. Major Graves testified that he had checked the calculations and figures made by complainant's witness, and found that they were correct, but that he did not believe the discharge tables of the Mississippi River Commission, used by Mr. Kemper, were reliable or of much value. He impressed upon the court that in drawing the plan, the Chief of Engineers and his assistants had discarded discharge observations and sought to use gages. His testimony later developed, however, that discharges were the basis used in arriving at the floodway needs.

Mr. Kemper testified that if the Cypress Creek fuseplug levee should break, a huge volume of water would come down with such energy that its destructive force would be enormous. "It will go down in a great wave, destroying houses, highways and fences. I do not believe there is any record of such a volume of water, with so much kinetic energy, being released into a confined diversion." It was admitted by Major Graves that a wall of water to some extent would be carried when the fuseplug at Cypress Creek should go out. He said he had seen one crevasse, and he would not make the statement that the adopted plan would create no disturbances in the floodway.

On the action of the fuseplug levee, Captain Dean said that the fall of water over the levee would dissipate its energy so that it would move down the valley at a comparatively slow rate. He said it would operate with a series of small crevasses. Cross-examination by H. H. Russell, attorney for the complainant, developed that Captain Dean has never seen a crevasse, that he never saw the lower Mississippi Valley until March, 1928, and since that time has spent five months in Europe.

General Jackson, like Captain Dean, admitted that, assuming a flood of the size of the 1927 flood and assuming the adopted plan in effect, more water would go down the Boeuf basin than did in 1927. He said that about 450,000 sec.-ft., the accepted estimate, went down the Boeuf in 1927, and that 600,000 sec.-ft. would have gone down with the adopted plan in effect.

Mr. Jacobs, for the complainant, said Kincaid's land had received protection from waters from the main channel of the river since 1920, when the Cypress Creek levee was closed. This was relevant to the clause in section 4 of the flood-control act concerning compensation for additional waters "from the main channel of the Mississippi." He also testified that the intended guide line levee east of Kincaid's property has a mean Gulf level of 83 and 84 ft. as compared with 66.9 ft. on Kincaid's property, which was declared to show that as much as 14 or 16 ft. of water was intended on the plaintiff's land.

National Policy on Highway Widening to Be Sought

An effort to curb the mounting number of fatalities and accidents, as well as to reduce the economic loss of millions of dollars due to traffic congestion in outlying metropolitan areas, was launched in Washington recently at the meeting of the American Automobile Association's committee on highway widening and segregation of grades. A committee was named to study the subject of highway widening in an effort to formulate a national policy. Its members are: Charles M. Hayes, Chicago, chairman; W. T. Calerdine, Cincinnati; George C. Diehl, Buffalo; W. A. Stinchcomb, Cleveland; Robert B. Brooks, St. Louis, and H. Happersberg, Long Island City.

Small Majority Against Buying Davenport Water Company

On Oct. 12 the voters of Davenport, Iowa, cast 2,809 ballots against and 2,496 for purchase of the property of the Davenport Water Company, giving a majority of 313 against. The total vote of 5,305 was only a fifth of the registration of 25,734.

The local company was acquired by the American Water Works & Electric Company not long ago. The rate was raised in February of this year, with a "gentlemen's agreement" given by the company that no further increases would be made for five years. Dissatisfaction over rates and friction between the consumers and the company were given by a committee of the city council as reasons for holding the election on purchase. The council was divided on calling the election, the vote being 4 to 3.

The company had agreed early this year to sell the works to the city for $2,900,000, which was said to be about $400,000 above what the American Water Works & Electric Company paid for the plant. On March 10, 1913, there was a popular vote of 2,856 against to only 1,217 for purchase by the city, but this was merely an advisory vote for the benefit of the city council of that time. The works had then been appraised at $1,511,300.

The population of Davenport by the state census of 1925 was 52,469, which was over 4,000 less than was shown by the United States census of 1920.

Memorial to Merritt H. Smith

A memorial to the late Merritt H. Smith, who was for a number of years chief engineer of the New York Department of Water Supply, Gas and Electricity, was unveiled on Oct. 19 at Kensico dam, Valhalla, N. Y. The memorial is in the form of a plaque commemorating Mr. Smith's work.

SOUTH CAROLINA BRIDGE WRECKED BY RECENT FLOOD

This state highway bridge consisted of nine 50-ft. concrete T-beam spans resting on two-post concrete bents. It was located on the Little Saluda River at what will be the headwaters of the Saluda dam reservoir and was completed early this year. Débris from logging operations upstream lodging against structure caused its collapse.

Boulder Dam Power Allotments Listed by Secretary Wilbur

Schedule Gives Equal Rights to Public Agencies and Utilities—Date Set for Further Hearing

PUBLIC agencies and the utilities are equal beneficiaries under the plan for allocation of Boulder dam power announced Oct. 21 by Secretary of the Interior Wilbur, following a series of conferences with the applicants that extended throughout the preceding week. The representatives of the Southern California Edison Company regard the plan outlined by Secretary Wilbur as tentative and will be prepared to present further arguments regarding several features of the matter at the hearing which has been assigned for Nov. 12.

Under Secretary Wilbur's decision the power will be divided, in general, on a 50-50 basis. The plan incorporates the proposal of the Southern California Edison Company that operation of the power plant shall be in the hands of a board of control on which the power company and the Metropolitan Water District of Los Angeles would have equal representation. As outlined by Secretary Wilbur, the power to be developed at the dam, subject to certain deductions, is to be contracted for as follows:

To the Metropolitan Water District of Southern California, 50 per cent or so much thereof as may be needed and used for the pumping of Colorado River water; to the city of Los Angeles, 25 per cent; and to the Southern California Edison and associated companies, 25 per cent.

Deductions Allowed

These allotments are to be subject to certain deductions which may arise through the exercise of preference rights—that is: (*a*) not exceeding 18 per cent of the total power developed for the State of Nevada for use in Nevada; (*b*) not exceeding 18 per cent of the total power for the State of Arizona, for use in Arizona, as above; and should either of the states not exercise its preference rights, the other may absorb them up to 4 per cent; (*c*) not exceeding 4 per cent for municipalities which have heretofore filed applications.

All such preference rights in whole or in part are to be exercised by the execution of valid contracts with the respective states and municipalities satisfactory to the Secretary, and the exercise of such preference rights is to reduce proportionately the above allotments to the district, the city and the company. Any state desiring to withdraw power within the limitations above stated must serve on the Secretary of the Interior written notice, within not less than twelve months, of the amount of power desired and for the purchase of which valid contracts satisfactory to the Secretary must be executed. Power contracted for but not required within a state shall be allocated to the city and the company on a 50-50 basis, with the reservation that it can again be called for within a reasonable time for use within the state. All power provided a state shall be at actual cost.

Should the 50 per cent allocated to the Metropolitan Water District be not required for pumping, this shall become available to the city of Los Angeles, 66⅔ per cent; to the Southern California Edison and associated companies, 33⅓ per cent. Any municipalities desiring the power within the limitation prescribed must execute the necessary contract therefor within twelve months from the date the contracts are made with the district, the city and the company. Any firm power available at the Boulder Canyon dam for the payment of which other contractors do not become and remain liable, aside from that allocated to the Metropolitan District, shall be taken and paid for by the city of Los Angeles and the Edison company on a 50-50 basis.

The contract for the available power is to be made with the city of Los Angeles and the Metropolitan Water District, with various subcontracts assuring the above, and providing for a board of control made up of two members nominated by the city of Los Angeles and the Metropolitan Water District, two by the Southern California Edison and associated companies, and one by the Secretary of the Interior, to act with the city of Los Angeles in the operation of the plant.

The federal government will install the dam, tunnels, power house and penstocks. The machinery for the generation and distribution of power is to be provided and installed by the lessee. The costs of installation and operation are to be borne by those contracting for the power in proportion to the amounts received. When the dam and power house are actually in operation the lessees may have the right to ask for a review of the actual cost of units of power and be entitled to deductions which will still permit the charge made to return to the government all advances and interest in accordance with the Boulder dam act, and provided further that if such review indicates that a higher rate should be paid for power to meet the obligation to the federal government, such an advance in rate will be put into effect.

Fair Price Clause

There will be a clause inserted in all of the contracts which will insure the distribution of all power developed at the Boulder dam at such a price as in the opinion of the Federal Power Commission is fair to all consumers. Should certain municipalities operating their own power plants desire to make separate agreements with the city of Los Angeles and the Metropolitan Water District, they shall be supplied with power at cost price.

The charge for storing water for the Metropolitain Water District will be 25c. per acre-foot.

Two Engineering Posts Open in Maryland

Two important engineering posts are to be filled by the Maryland Public Service Commission. The commissioners are now turning their attention to the task and are expected to take action in the near future. One place to be filled is that of chief engineer. This post has been vacant since the resignation of H. Carl Wolf several months ago. The commission probably will request that the state employment commissioner hold an examination to create an eligible list. The other post is that of service engineer. This was held by Ray Y. Gildea, who resigned shortly after Mr. Wolf left the commission.

Municipal Engineers Show Record Growth at Philadelphia Meeting

Increase in Membership and Financial Strength Revealed—Equipment and Planning Projects Exhibited

Engineering News-Record Staff Report

WIDE SPREAD of subjects in both papers and reports characterized the 35th annual convention, Oct. 14 to 18, of the American Society of Municipal Improvements at Philadelphia, Pa. Several standard specifications, as noted elsewhere, were adopted by the convention and sent to letter ballot for final adoption. Thirteen past-presidents, all of whom are ex-officio members of the executive committee, were present. Three vice-presidents were advanced in the following order: president, P. L. Brockway, city engineer, Wichita, Kan.; first vice-president, John W. Reid, city engineer, Detroit; second vice-president J. H. Neeson, chief engineer, Bureau of Surveys, Philadelphia. S. A. Greeley, consulting engineer, Chicago, was elected third vice-president, and C. W. S. Sammelman was re-elected secretary, Richmond, Va., was chosen as the place of meeting in 1930.

The secretary reported four times as many new members joining as in any of the last few years, there now being 594 members of all grades. The society has passed into decided solvency with assets of $3,800 and seems to have justified the action of putting on the full-time secretary. Attendance registration was about 425 the first day and ultimately exceeded 600. The first session was swelled in size through a joint meeting with the Philadelphia Municipal Engineers Society.

Twenty-six exhibits were shown, including six on paving materials, four on roadmaking equipment, three on surveying instruments, one on street sweepers, two by contractors, one on garbage destructors, one on sewer joints, two by technical publishers and three by associations of material interests. In a separate room was shown an elaborate exhibit of the regional and city planning projects under way.

Construction of $1,500,000 Plant Started in Ontario

The contract has been let and work has started on the new plant of Canadian Industries, Ltd., at Copper Cliff, Ontario, where the company is establishing an industry to utilize smelter gases from the International Nickel Company's nickel-copper industry. The plant and equipment involve an expenditure of $1,500,000. The contract has been awarded to Fraser, Brace & Company, of Montreal. The initial plant is for the production of sulphuric acid and niter cake.

250,000-Hp. Development on Ottawa River

The Royal Securities Corporation, of Montreal, which controls the power rights on the Quebec side of the Ottawa River at Chats Falls, has awarded a contract to the Morrow & Beatty Company, of Peterboro, Ont., for the erection of a 30-ft. dam for the development of 250,000 hp. The work is undertaken in conjunction with the Ontario government, which will shortly let a contract for the completion of the dam across the river. The entire structure will cost from $3,000,000 to $5,000,000.

Street Sanitation Officials Elect Officers

Lester W. Hartzog, of Albany, N. Y., was elected president of the International Association of Street Sanitation Officials at the recent meeting in Jacksonville, Fla. Other officers elected are: Edward C. Goodwin, New York City, first vice-president; H. D. Bradley, Toronto, Canada, second vice-president; Carl Schneider, New Orleans, third vice-president; P. G. Hurtgen, Kenosha, Wis., treasurer; A. M. Anderson, Chicago, secretary. Selection of the next meeting place will be made later at a conference to be held in Chicago.

Colonel Kutz, Corps of Engineers, Seeks Retirement

Col. Charles W. Kutz, Corps of Engineers, former engineer commissioner of the District of Columbia and now the senior officer of his grade in the Corps on the active list, has applied to the President for transfer to the retired list of the army Feb. 1 next.

Colonel Kutz has been in command of the Third Engineer Combat Regiment in the Hawaiian division, with station at Schofield Barracks, Oahu, since July, 1928. He is the second high-ranking engineer officer recently to seek retirement, Col. William P. Wooten, the other, already having had his application passed on favorably by the President.

During his 36 years in the army, Colonel Kutz has seen service at Baltimore, Md.; Portland, Me.; in the office of the Chief of Engineers, Washington; at the West Point Military Academy; at Seattle, Wash., and in the Philippines from 1911 to 1914. In 1914 he was appointed engineer commissioner of the District of Columbia and served as such until the United States entered the World War in 1917, when, on his own application, he was appointed a colonel of Engineers in the national army for service in France. Shortly after the signing of the Armistice, in November, 1918, he was reinstated in the office of engineer commissioner of the District and continued in that office until 1921, when he was ordered to Cincinnati to take charge of the Central Engineer Division. In July, 1928, he was transferred to Hawaii for duty with troops.

Montana Rail Extension Proposed by Northern Pacific

The Northern Pacific Railway has filed application with the Interstate Commerce Commission to extend its line from Brockway to Lewistown, Mont., 208 miles. The project contemplates use of the tracks of the Chicago, Milwaukee, St. Paul & Pacific from Winnett to Lewistown, leaving a total of 149 miles of new construction. The proposed line would afford a shorter route to St. Paul, Duluth and Chicago. The Northern Pacific previously had filed application to build from Brockway to Edwards, 89 miles.

The Business Outlook

Business sentiment has been somewhat clouded by further evidences of declining activity in the heavy industries. American business ignores the fact that in most lines general business remains above last year's levels. This is not yet a one-industry country. Wide fluctuations in even a few basic industries do not disturb the slow and regular growth of general trade. The banking position is exceptionally strong, production is closely controlled, retail trade and general employment are well sustained. Should business show further signs of fatigue, the banking system is in a good position now to administer any needed credit tonic. Business may continue slightly slower for the rest of the year, but will still be at an unusually high level compared with the past.

The steel industry as a whole is operating at 79 per cent of capacity, as compared with 84 per cent in the preceding week and 88 per cent last year. So far, building has not been so seriously cut as it is likely to be in coming weeks as the cumulative effect of tight money for building purposes shows itself.

—The Business Week, Oct. 19.

License Requested for Power Plant on Lower Susquehanna

Application has been made to the Federal Power Commission by the Safe Harbor Water Power Corporation, Holtwood, Pa., for a license to construct a dam and generating station about 10 miles above the present Holtwood dam of the Pennsylvania Water & Power Company on the Susquehanna River. The proposed dam would be 3,635 ft. long and would develop a head of 52.5 ft. Six generating units would be installed, with a capacity total of 231,000 hp.

WASHINGTON NOTES

By Paul Wooton
Washington Correspondent

Floodway Projects May Be Restudied—A.G.C. Working Out Prequalification Law

STATEMENTS made during the past week by President Hoover to Senator Robinson, of Arkansas, and to members of the Louisiana State Flood-Control Board are interpreted as indicating clearly that he is satisfied with the support already received for the suggestion that the work on the west bank floodways in Louisiana be suspended pending further studies. While only the Arkansas delegation and four members of the Louisiana delegation in Congress were willing to sign a written statement sharing the responsibility for the delay, it is thought that the President regards these assurances, together with the formal support of the proposal by the Louisiana Flood-Control Board and practically the entire body of civilian engineers, as sufficient to justify him in waiting on further expression of engineering opinion. It also was revealed that the army engineers are engaged in a study of a narrow, controlled floodway through the Boeuf Basin.

M.R.C. Headquarters

Transfer of the headquarters of the Mississippi River Commission from St. Louis to Vicksburg has raised a storm of protest in the former city. Delegations composed of prominent persons representing each of the cities concerned have conferred with the President and the Secretary of War. The St. Louis delegation contends that flood-control work can be administered more effectively from St. Louis than from any other point and cites the experience of the Mississippi River Commission over a long period of years. It was pointed out further that most of the members of the commission's staff own their homes in St. Louis and that it will be a great hardship to require them to move. Better rail facilities and the availability of commercial equipment in connection with map making and photostating are to be had in St. Louis, it was argued. The representatives of Vicksburg pointed out that its location in the very center of flood-control operations would greatly increase the effectiveness of the commission. It was asserted that ample housing is available for the commission's personnel and that the cost of living is much lower in Vicksburg than in St. Louis. It was denied that the commission would suffer in any way from lack of commercial photostating or other equipment.

Shifting Engineer Officers

The Secretary of War has drafted a bill providing for the exemption of Engineer officers from duty with troops so that they may be retained on important engineering projects when deemed advisable. The proposal is certain to meet with some opposition in Congress,

where some members believe that the rotation of Engineer officers constitutes an element of the Corps' strength. The legislation is intended to apply principally to the officers in charge of the newly created branches of the Corps of Engineers, but is broad enough to apply generally in the Corps when the Secretary sees fit to grant exemptions.

A.G.C. Activities

As the result of recent conferences of the executive board of the Associated General Contractors, plans are being made to intensify all activities tending toward the elimination of bad credit practices and the general improvement of conditions in the industry. The five objectives stressed in the housecleaning campaign include: prequalification of contractors, institution of more rigid examination of contractor applicants for surety bonds, elimination of loose credit in the sale of construction equipment, greater care in extending banking credit to contractors and the curbing of loose credit in selling construction materials to contractors.

To aid the various states in adopting prequalification ordinances, a model act is in the course of development by the surety division of the association. In drafting this model act, particular attention is being given to the question of legality. This is because some of the states have had their proposed prequalification acts vetoed due to overzealousness in drawing them up. It is expected that great stimulus will be given the campaign for prequalification legislation during the coming convention of the American Association of State Highway Officials. This will be the first time that a convention of state highway officials has devoted any great amount of consideration to prequalification.

Cement Price Discounts

Steps have been taken toward removing the most controverted point between contractors and the cement industry. The contractors have long complained over what they regarded as preferential discounts extended by cement dealers to public bodies. In this manner, it has been complained, municipalities have bought cement at lower rates than those for which the contractors are able to get it, thus encouraging the undertaking of public construction work with day labor. Negotiations are under way with leading cement manufacturers and dealers to devise some means of correcting this situation.

Construction Safety

The position of the Associated General Contractors as being opposed to the passage of detailed legislation to aid in accident reduction has been emphasized again. It has been decided to continue resistance to the efforts of various agencies seeking the establishment of complicated safety codes. The best means of reducing accidents in the construction industry lies in education work in the industry itself, the contractors feel.

Personal Notes

GEORGE H. CLIFFORD has been elected president of the Stone & Webster Service Corporation, succeeding HARRY H. HUNT, who has been made chairman of the board of directors. Mr. Clifford has been with the Stone & Webster organization for 28 years.

H. L. RIPLEY, of Boston, corporate and valuation engineer of the New York, New Haven & Hartford Railroad, has been made assistant to Vice-President C. E. Smith, of that road.

JOHN A. BEEMER, formerly chief engineer, Montague Water Conservation District, Montague, Calif., is now in Russia as consulting engineer to the Russian Soviet government on the Transcasia irrigation work at Tiflis.

J. P. THOMPSON has been appointed Eastern district engineer for the Concrete Reinforcing Steel Institute, with office in New York. He was formerly with the Portland Cement Association.

I. C. DANIEL, formerly resident engineer on bridge construction in the Arkansas highway department, is now in the standard building department of the Truscon Steel Company, Youngstown, Ohio.

P. S. MONK, who was recently in the employ of the city of Pittsburgh, Pa., as division engineer in the Bureau of Bridges and Structures, has accepted a temporary appointment as associate highway bridge engineer in the Bureau of Public Roads, Washington, D. C., and is now engaged on the designs and preparation of contract plans for the bridges on the new Mount Vernon Memorial Boulevard.

Society Calendar

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS, Washington; annual meeting, San Antonio, Tex., Nov. 12-15.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION, New York; annual convention, Biloxi, Miss., Nov. 13-16.

AMERICAN ROAD BUILDERS ASSOCIATION, Washington; annual convention, Atlantic City, N. J., Jan. 11-18.

ASPHALT PAVING CONFERENCE, New York City; annual meeting, West Baden, Ind., Oct. 28-Nov. 1.

INTERNATIONAL CITY MANAGERS ASSOCIATION, Chicago; annual convention, Fort Worth, Tex., Nov. 20-23.

NATIONAL PAVING BRICK MANUFACTURERS ASSOCIATION, Washington; annual meeting, Chicago, Ill., Dec. 4-6.

SOUTHWEST WATER WORKS ASSOCIATION, Fort Worth, Tex.; annual convention, Tulsa, Okla., Oct. 28-30.

MISSOURI VALLEY SECTION, American Water Works Association, Iowa City; annual meeting, Sioux Falls, S. D., Nov. 6-8.

NORTH CAROLINA SECTION, American Water Works Association, Chapel Hill; annual meeting, High Point, N. C., Nov. 4-6.

THE NASHVILLE ENGINEERING ASSOCIATION will be host to the engineering clubs of Memphis, Knoxville and Chattanooga on Nov. 23 at an all-day meeting in celebration of the 40th anniversary of the Engineering Association of Tennessee.

Obituary

WILLIAM DUDLEY MORRISON, secretary of Morrison & Gates, contracting engineers, Denver, Colo., died on Oct. 3.

PAUL PICCARD, Swiss engineer, who constructed the first hydraulic turbines at Niagara Falls, died in Lausanne, Switzerland, on Oct. 18. He was 86 years old.

CHESTER HASTINGS STILLMAN, senior engineer in the highway division, U. S. Department of Agriculture, died on Oct. 9 in his home in Troy, N. Y., at the age of 56 years. He had recently been in charge of highway construction in Vermont.

ARTHUR C. SCOTT, of Dallas, Tex., consulting engineer for numerous Dallas firms, died on Oct. 13. Mr. Scott had supervision over rebuilding the dam and reservoir on the Colorado River, as well as the hydro-electric plant for the city of Austin. Also he had charge of the installation of water, power and light apparatus and street lighting for the city of Cameron and drew plans and specifications for the light and power plant at Nacogdoches, Tex.

THOMAS HASTINGS, of New York, member of the architectural firm of Carrere & Hastings, died on Oct. 22, aged 66. Among the examples of Mr. Hastings' work are the New York Public Library, the Ponce de Leon Hotel at St. Augustine, Fla., the Senate and House of Representatives' office building in Washington, the Manhattan bridge approaches and decorations, St. Ambrose's Chapel in the Cathedral of St. John the Divine in New York and the Arlington Memorial Amphitheater in Arlington Cemetery, where the unknown soldier is entombed.

ALEXANDER M. TODD, senior civilian engineer, Vicksburg District, U. S. Engineer Office, Vicksburg, Miss., died Sept. 11 while on duty. Mr. Todd was born in 1874 in Rankin County, Miss. After graduation from Texas A.&M. College in 1894 he immediately entered federal service as a rodman in the old Third District of the Mississippi River Commission. He rose through all the ranks of the civilian engineering grades to the top final promotion of senior engineer in 1927. During the war he was made district engineer of the Third District. He devoted his life to river control in the district and successfully developed many of the methods and improvements now utilized to save time and costs. He made the basic surveys for the power development and attendant flood control on the upper Ouachita River. His name is noted on one of the central key positions and shown in the chart of organization of the Vicksburg District described in the article in *Engineering News-Record* on p. 572, Oct. 10 issue. Mr. Todd was the senior member of the American Society of Civil Engineers in Mississippi, a member of the Society of American Military Engineers and active in local social and civic clubs.

Construction Equipment and Materials

Material-Handling Equipment Ordered for Presque Isle

Coal- and ore-handling machinery for the port of Presque Isle, Ohio, recently ordered by the Hocking Valley Railroad, represents the most modern development in this type of equipment. The complete pier installation will consist of two 120-ton lifting turning car dumpers, each capable of handling 60 cars per hour, to be supplied by the Industrial Brownhoist Corporation; and three 17-ton stiff-leg ship unloaders which will be built by the Wellman-Seaver-Morgan Company. These will each transfer 17 tons of ore per cycle. Electric pusher locomotives will handle the cars. Power for the installation will be supplied by three sub-stations using Westinghouse equipment.

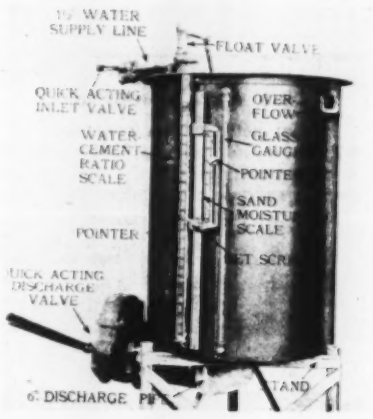
Entries Sought for Industrial Advertising Award

With the object of raising the standards of industrial advertising, more entries are being sought for the annual Bok award of $2,000 for the best industrial advertising campaign appearing in newspapers and periodicals in 1929. The closing date for entries is Dec. 31, 1929. To enter the competition, the advertiser must submit certain required information in a prescribed form. Full details can be secured from the Harvard Graduate School of Business Administration, Soldiers' Field Station, Boston, Mass.

New Developments

Measuring Tank Holds Water-Cement Ratio Constant

For controlling the amount of water used in the mixing of concrete in order to keep the water-cement ratio constant the Blaw-Knox Company, Pittsburgh, Pa., has developed a measuring tank for use with mixers of 1, 2 and 3 cu.yd. capacities and intermediate sizes. The device is made for either manual or automatic operation, both forms having open-top tanks equipped with calibrated brass scales and water-gage glasses showing the level in the tank at all times. In the manually operated tank, the operator sets a pointer opposite the exact number of pounds of cement to be used in the batch and in accordance with the water-cement ratio specified. An auxiliary scale is provided to compensate for the amount of water contained in the aggregate. Water is admitted to the tank until it is full, when it is shut off by



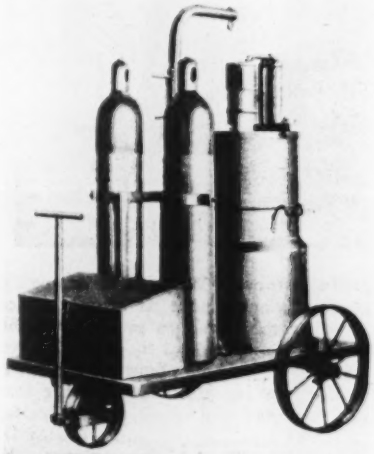
MANUALLY OPERATED WATER TANK FOR CEMENT MIXER

means of a float valve. An overflow prevents overfilling. Water for the batch is then fed into the mixer by opening the discharge valve until the level has dropped to a point opposite the pointer.

The automatic tank is similar in arrangement, except that it is fitted with an adjustable overflow funnel inside the tank which is automatically set opposite the pointer. The tank is filled only to the determined level, and is entirely emptied when discharged.

Trucks for Acetylene Welders

Easy transportation of materials for oxyacetylene welding is provided in two trucks especially developed for this purpose by the Oxweld Acetylene Company, New York City. These carry the

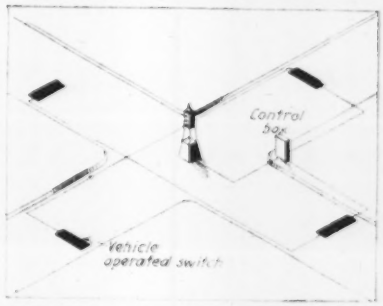


TRUCK CARRIES WELDING APPARATUS

low-pressure acetylene generators made by the company, as well as oxygen cylinders and incidental equipment. Both models are of the three-wheel type, with two large wheels carrying the main portion of the load supplemented by a third wheel of the caster type to allow easy maneuvering. In the larger truck, for use with the type CLP-3 Carbic generator, a telescoping crane is provided for use in charging and emptying the generator. Racks are provided for two cylinders of oxygen. The smaller truck, for use with the CLP-2 generator, carries only one cylinder of oxygen.

Traffic Directed Automatically by New Device

Efficient control of traffic at street intersections of all types is the function of the Electro-Matic vehicle-actuated traffic dispatching system developed by the Automatic Signal Corporation, New Haven, Conn. This can be used with any standard make of signal light. There are two parts to the apparatus: pavement units which are sensitive to the presence and movement of approaching vehicles, and a control mechanism which receives impulses from the pavement units and operates the lights. The pavement units are placed in each street a short dis-



TRAFFIC-CONTROL INSTALLATION

tance from intersection. They contain no moving parts, being actuated by pressure only.

With this control system in operation, a single car approaching an empty intersection receives the green light and is not required to stop. Ordinarily, however, the light will remain green for the more heavily traveled street. Should two cars arrive at right angles at exactly the same instant, the light holds steady until one car has had time to pass, and then the other is permitted to enter the crossing. No traffic, however, is stopped unless opposing traffic is actually using the intersection. When a continuous stream of vehicles is passing on one street, the green light remains on until traffic appears on a side street. As soon as this occurs, the control begins to look for a gap in the main traffic and, upon finding one, switches the green light to the side street. If no gap appears within a certain set time, the light is changed arbitrarily.

The same type of pavement unit is

used to actuate traffic counters, tabulators and flow meters manufactured by this company. These may be obtained for either temporary or permanent installation for general traffic-survey work or for other purposes. They are so designed that impulses from the front and rear wheels are recorded as one car only. Records are given in tabular or chart form, or may be read directly.

Waterproofing Compound Uses Iron as Base

Besides acting as a hardener and waterproofer for concrete, the compound "Irox," manufactured by the U. S. Waterproofing Company, Chicago, Ill., can also be used in binding new concrete to old, either in making repairs or in adding to a structure. Irox is a combination which has as its base finely ground iron in combination with other chemicals. When mixed with water and applied with a brush, the compound fills the pores and voids of the treated surface. The action of the water in combination with the chemicals rapidly oxidizes the iron, the particles expanding from two to three and one-half times their original size. When fully oxidized and expanded, further chemical action hardens the particles, completely closing the pores and forming a seal. When new concrete is added to old, the old surface is painted with Irox, and the new concrete, also containing the compound, is added.

Costs and Contracts

E. N.-R. Index Numbers

Cost			Volume		
Oct. 1, 1929		**206.32**	**Sept., 1929**		**340**
Sept. 1, 1929		207.57	August, 1929		290
Oct. 1, 1928		207.71	September, 1928		296
Average, 1928		206.78	Average, 1928		287
Average, 1927		206.24	Average, 1927		263
1913		100.00	1913		100

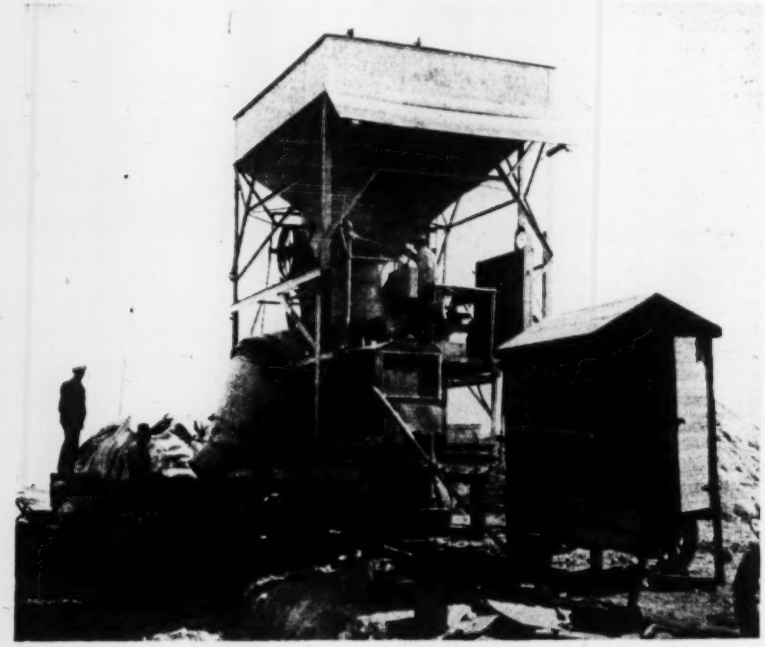
This Week's Contracts

Heavy construction contracts, reported by *Engineering News-Record* in the week of Oct. 24, with some comparisons, total as follows:

(In Thousands of Dollars)

	Oct. 24, 1929	Oct. 17, 1929	Oct. 25, 1928
Building:			
Industrial	$7,886	$8,866	$10,318
Commercial	30,694	29,346	59,576
Streets and roads	7,064	14,305	10,720
Other eng. constr.	10,318	8,231	9,768
Total	$55,962	$60,748	$90,382
Total, all classes, Jan. 1 to Oct. 24:			
1929			$3,454,521
1928			3,035,459

CENTRAL MIXING PLANT TRANSPORTED ON TRAILERS



Transfer of a central mixing plant from job to job has been greatly facilitated by Bert Noble, of San Diego, Calif., who has mounted a standard Smith 40-S tilting mixer with Weigh-Mix attachment on a trailer. This is used in connection with a demountable steel bin of 50-ton capacity, together with a Koehring crane and a cement elevator which lifts the cement to a small hopper immediately beneath the gravel hopper. When it is desired to move the equipment, it is only necessary for the crane to pick up the bin and elevator and load them on a second trailer. The entire plant is then towed to the new location. Mr. Noble himself mounted the mixer on the trailer, built the steel hopper and elevator leg and also mounted his own motor. He states that only four hours is required to dismount and re-erect the plant.

Business Notes

JEFFREY MANUFACTURING COMPANY, Columbus, Ohio, has purchased the Bakstad Crusher & Equipment Corporation, of Chicago, Ill., and will henceforth manufacture and market the Bakstad 3-Jaw crusher as part of the regular Jeffrey line. J. H. Bakstad, who designed the machine, has been appointed manager of sales of the crusher and pulverizer division of the Jeffrey company. Sales of the Jreffrey-Bakstad units will be handled by G. P. Puhl, formerly of the Bakstad sales staff.

AMERICAN ROLLING MILL COMPANY, Middletown, Ohio, has appointed M. E. Danford assistant vice-president of the company. Mr. Danford for more than seven years has been works manager of the Middletown division of the company.

New Publications

Liquid Oxygen Explosive—KEITH DUNHAM COMPANY, Chicago, Ill., explains the use of liquid oxygen as an explosive in an illustrated booklet recently issued. The oxygen is used in connection with a special cartridge under the name of Loxite. Storage hazards are eliminated by keeping the two ingredients separate until ready for use, and it is stated that, due to evaporation of the liquid oxygen, missed holes present on hazard several hours after a blast.

Flooring—NATIONAL LUMBER MANUFACTURERS ASSOCIATION, Washington, D. C., is distributing a 30-p. illustrated booklet "Wood Floors," giving reasons for the use of wood in floor construction and directions for proper laying and finishing. Tables are included showing the commercial grades and sizes of flooring lumber available in several different woods.

Roadbuilding Machinery—W. A. RIDDELL COMPANY, Bucyrus, Ohio, has published a 32-p. mid-season road machinery catalog illustrating and describing Warco power graders, rollers, wheeled scoops and other products.

Electric Motors—WAGNER ELECTRIC CORPORATION, St. Louis, Mo., devotes bulletin 165 to a discussion of the performance characteristics of squirrel cage motors of seven different types.

Doors—R. C. MAHON COMPANY, Detroit, Mich., has issued a folder describing rolling steel doors for industrial and commercial buildings. Installation data are given.

Explosives—HERCULES POWDER COMPANY, Wilmington, Del., in a 44-p. illustrated booklet gives directions for the safe and proper use of commercial explosives. The booklet, which is intended to aid users of explosives in improving blasting practice and avoiding accidents, lists various types of explosives and gives their characteristics. Directions for the handling, storage, loading, priming and firing are given in detail.

Sanitary Engineering Equipment—DORR COMPANY, New York City, in a 22-p. illustrated booklet, "Modern Sanitary Engineering Practice," outlines various fundamental operations involved in the treatment of municipal sewage and industrial wastes and in water purification and treatment.

Concrete Mixers—RANSOME CONCRETE MACHINERY COMPANY, Dunellen, N. J., in bulletin 122 describes in detail the 56-S and 84-S mixers developed for large construction jobs, central mixing plants and other installations where large volumes are necessary.

Surveying Instruments—C. L. BERGER & SONS, INC., Boston, Mass., has published in Spanish a complete catalog of its products. This takes the form of a 150-p. illustrated leather-bound book. The company has also published two paper-bound pamphlets "Berger Focusing Systems for Engineering and Surveying Instrument Telescopes" and "The World's Finest Engineering and Surveying Instruments." These are available in either English or Spanish.

Air-Cooled Engines—NEW-WAY MOTOR COMPANY, Lansing, Mich., in catalog 11 describes the New-Way twin air-cooled engine developing from 6 to 10 hp.

Core Drills—SULLIVAN MACHINERY COMPANY, Chicago, Ill., describes a pavement core drill for motor truck mounting in an 8-p. illustrated bulletin 85-C.

Diesel Engines—BUCKEYE MACHINE COMPANY, Lima, Ohio, has issued a 24-p. illustrated catalog on diesel engines manufactured in three-, four- and six-cylinder types developing from 200 to 400 hp.